DANA SPICER®
Off-Highway Products

Service Manual

Powershift Transmission
T20000 3- & 6-Speed
Long Drop with Range Shift

TSM-0224
June 2012

TOWING OR PUSHING

Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

Note

If the transmission has 4 wheel drive, disconnect both front and rear drivelines. Because of the design of the hydraulic system, the engine cannot be started by pushing or towing.

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FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the ***SPICER OFF-HIGHWAY PRODUCTS*** product.

Extreme care has been exercised in the design, selection of materials, and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the product, its principle of operation, troubleshooting and adjustments, it is urged that the mechanic studies the instructions in this manual carefully and uses it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only ***SPICER OFF-HIGHWAY PRODUCTS*** approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger proper operation and performance of the equipment. ***SPICER OFF-HIGHWAY PRODUCTS*** does not warrant repair or replacement parts, nor failures resulting from the use of parts which are not supplied by or approved by ***SPICER OFF-HIGHWAY PRODUCTS*** **.**

IMPORTANT

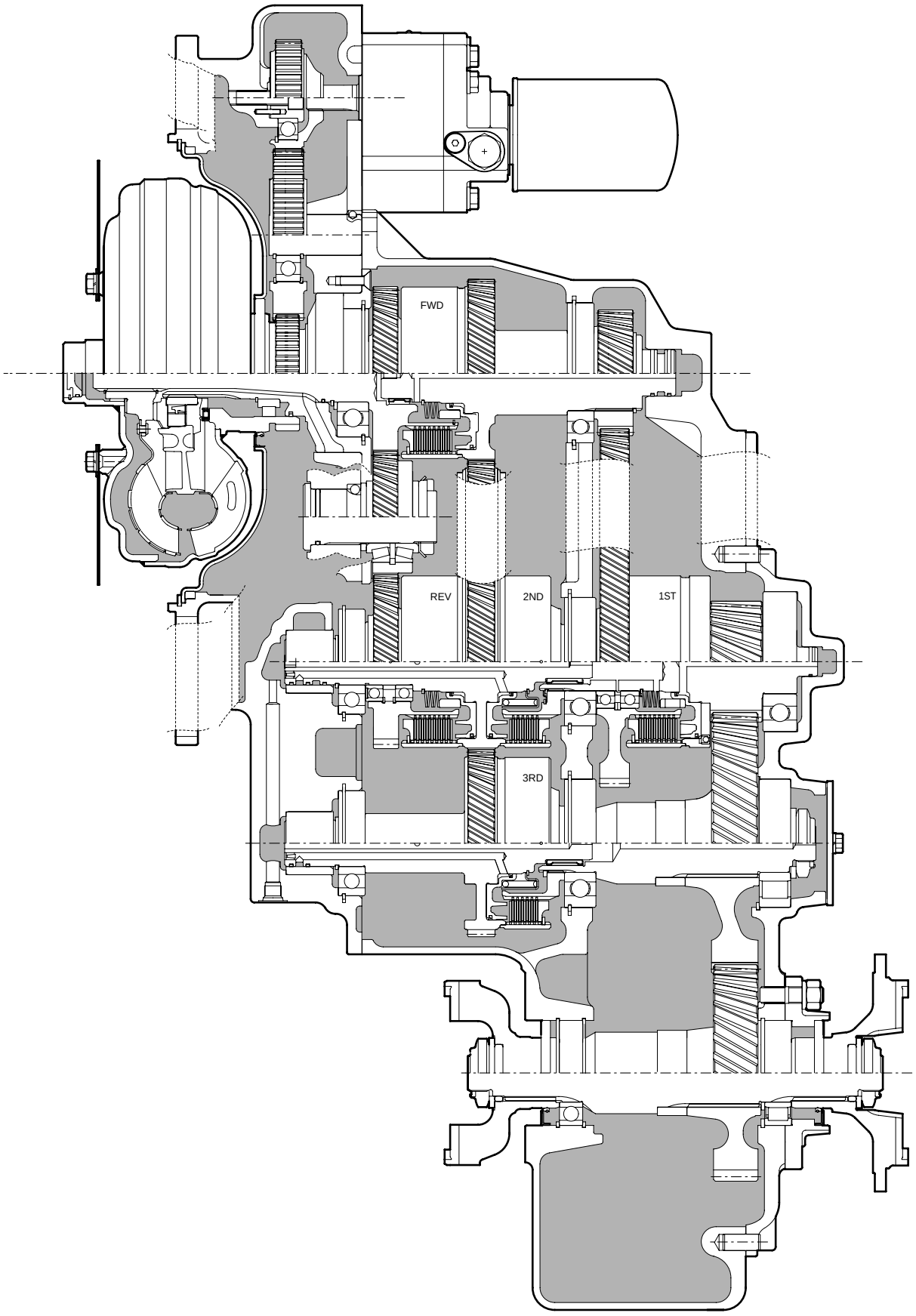
ALWAYS FURNISH THE DISTRIBUTOR WITH THE SERIAL AND MODEL NUMBER WHEN ORDERING PARTS.

When checking the difference between a 6-speed with range shift, a 3-speed standard ratio and a 3-speed deep ratio, you would notice that the difference is only on the idler and the output shaft.

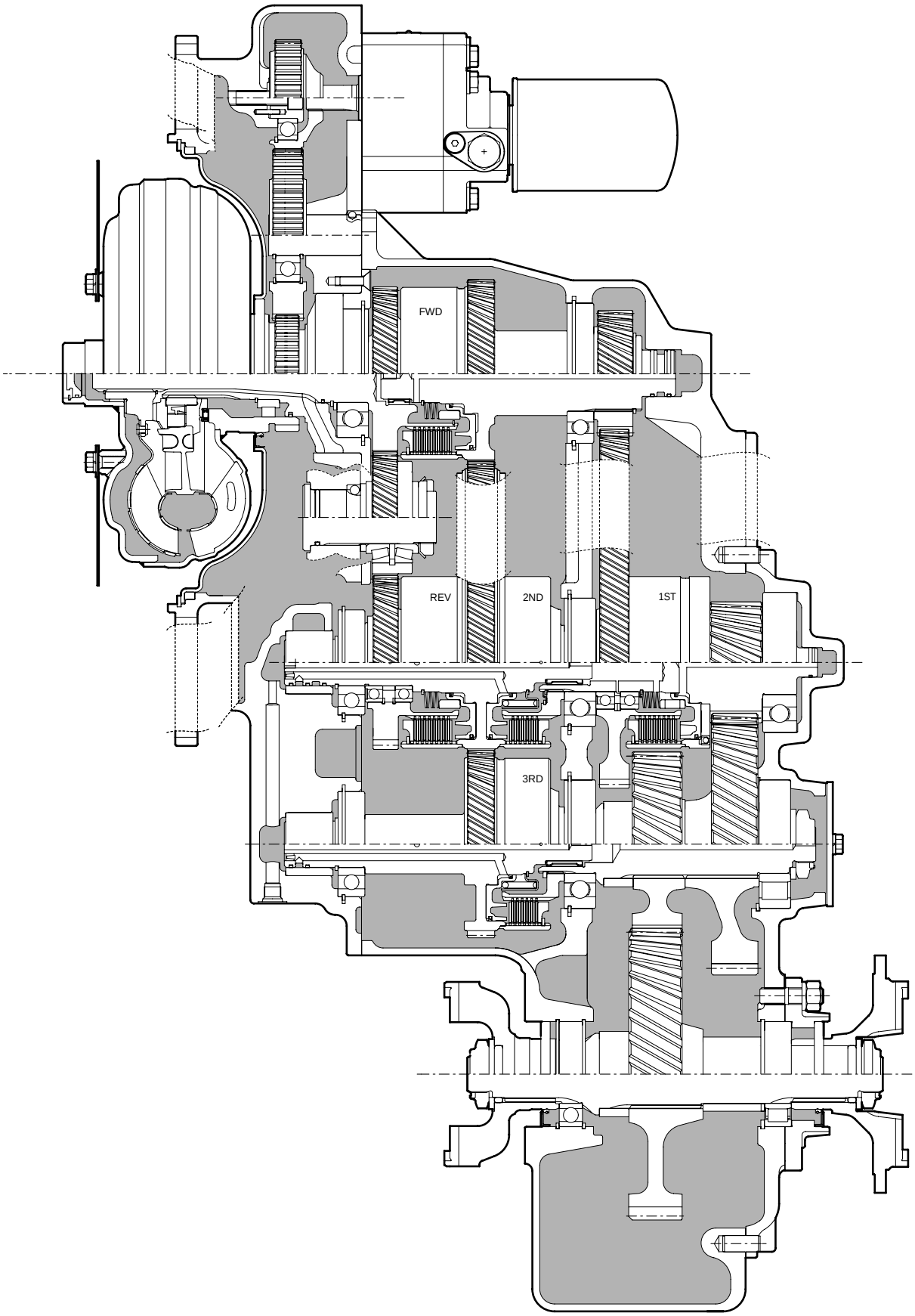
A 3-speed standard is similar to a 6-speed with range shift when high range is selected. While a 3-speed deep ratio is similar to a 6-speed with range shift when low range is selected.

For this reason, we will use the 6-speed with range shift in most cases to explain the function of the 3 different transmissions.

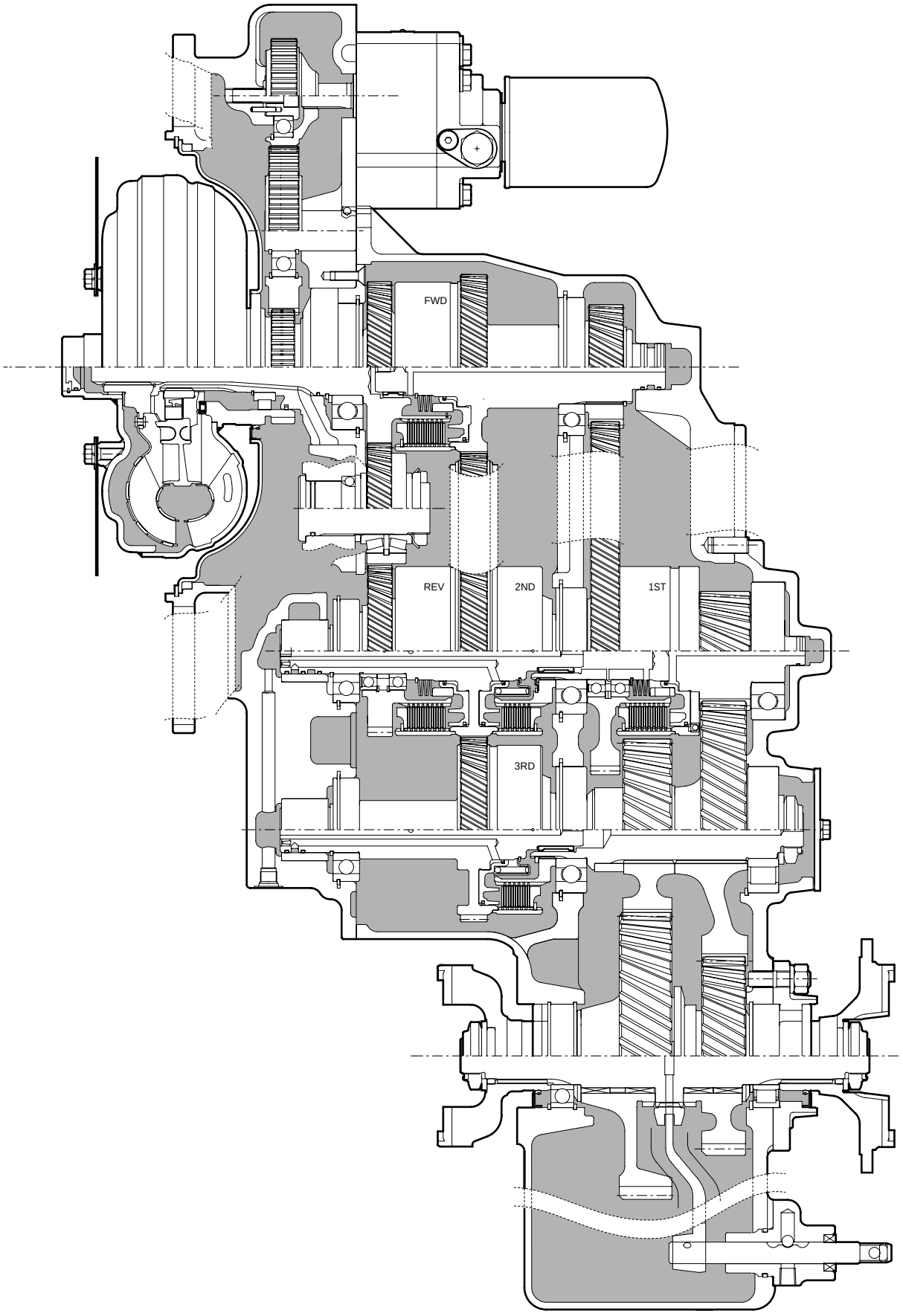
3-SPEED STANDARD RATIO



3-SPEED DEEP RATIO



6-SPEED RANGE SHIFT



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1. SAFETY PRECAUTIONS

To reduce the chance of personal injury and/or property damage, the following instruction must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the machine. If replacement parts are required the part must be replaced by a spare part which has the same part number or with an equivalent part. Do not use a spare part of lesser quality.

The service procedures recommended in this manual are effective methods for performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a spare part, service procedure or tool, which is not recommended by ***SPICER OFF-HIGHWAY PRODUCTS***, must first determine that neither his safety nor the safe operation of the machine will be jeopardized by the spare part, service procedure or tool selected.

IMPORTANT

IT IS IMPORTANT TO NOTE THAT THIS MANUAL CONTAINS VARIOUS 'CAUTIONS' AND 'NOTICES' THAT MUST BE CAREFULLY OBSERVED IN ORDER TO REDUCE THE RISK OF PERSONAL INJURY DURING SERVICE OR REPAIR, OR THE POSSIBILITY THAT IMPROPER SERVICE OR REPAIR MAY DAMAGE THE UNIT OR RENDER IT UNSAFE. IT IS ALSO IMPORTANT TO UNDERSTAND THAT THESE 'CAUTIONS' AND 'NOTICES' ARE NOT EXHAUSTIVE, BECAUSE IT IS IMPOSSIBLE TO WARN ABOUT ALL THE POSSIBLE HAZARDOUS CONSEQUENCES THAT MIGHT RESULT FROM FAILURE TO FOLLOW THESE INSTRUCTIONS.

2. CLEANING, INSPECTION AND LEGEND SYMBOLS

2.1 CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION

CARE SHOULD BE EXERCISED TO AVOID SKIN RASHES, FIRE HAZARDS, AND INHALATION OF VAPOURS WHEN USING SOLVENT TYPE CLEANERS.

2.1.1 Bearings

Remove bearings from cleaning fluid and strike flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

2.1.2 Housings

Clean interior and exterior of housings, bearing caps, etc…, thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION

CARE SHOULD BE EXERCISED TO AVOID INHALATION OF VAPOURS AND SKIN RASHES WHEN USING ALKALI CLEANERS.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal fillings, contaminated oil, or lapping compound.

2.2 INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

2.2.1 Bearings

Carefully inspect all rollers: cages and cups for wear, chipping, or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in Automatic Transmission Fluid and wrap in clean lintless cloth or paper to protect them until installed.

2.2.2 Oil Seals, Gaskets, Etc.

Replacement of spring load oil seals, “O”-rings, metal sealing rings, gaskets, and snap rings is more economical when unit is disassembled than premature overhaul to replace these parts at a future time. Further loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. When assembling new metal type sealing rings, these should be lubricated with coat of chassis grease to stabilize rings in their grooves for ease of assembly of mating members. Lubricate all “O”-rings and seals with recommended type Automatic Transmission Fluid before assembly.

2.2.3 Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks, or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they are not sprung, bent, or splines twisted, and that shafts are true.

2.2.4 Housing, Covers, etc.

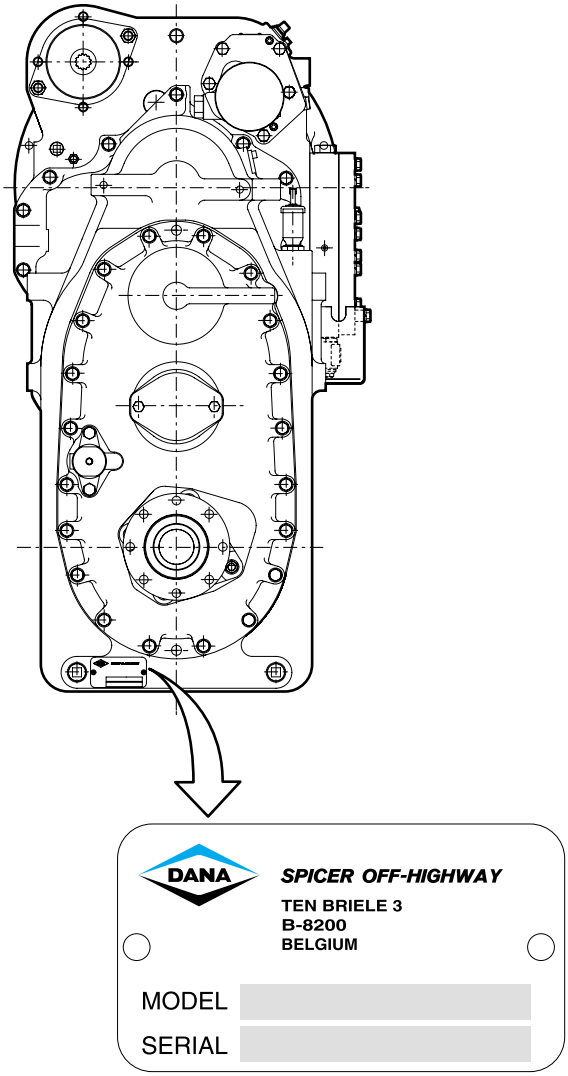
Inspect housings, covers and bearing caps to ensure that they are thoroughly clean and that mating surfaces, bearing bores, etc…, are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures.

2.3 LEGEND SYMBOLS

	Smontaggio di sottogruppi Disassembly of assembly groups
	Montaggio di sottogruppi Reassemble to from assembly group
	Smontaggio di particollari ingombranti Remove obstruction parts
	Montaggio di particollari ingombranti Reinstall - remount parts which had obstructed disassembly
	Attenzione, indicazione importante Attention! important notice
	Controllare regolare p.e. coppie, misure, pressione etc. Check - adjust e.g. torque, dimensions, pressures etc.
	T = Attrezzature speciali P = Pagina T = Special tool P = Page
	Rispettare direzione di montaggio Note direction of installation
	Controllare esaminare controllo visuale Visual inspection
	Eventualimente riutilizzable (sostituire se necessario) Possibly still serviceable, renew if necessary

	Sostituire con ogni montaggio Renew at each reassembly
	Togliere - mettere la sicura Unlock - lock e.g. split pin, locking plate, etc.
	Mettere la sicura, incollare (mastice liquido) Lock - adhere (liquid sealant)
	Evitare danni ai materiali, danni ai pezzi Guard against material damage, damage to parts
	Marchiari prima dello smontaggio (per il montaggio) Mark before disassembly, observe marks when reasembl.
	Carricare riempire (olio - lubrificante) Filling - topping up - refilling e.g. oil, cooling water, etc.
	Scarricare olio, lubrificante Drain off oil, lubricant
	Tendere Tighten - clamp ; tightening a clamping device
	Insere pressione nel circuito idraulico Apply pressure into hydraulic circuit
	Pulire To clean

3. TECHNICAL SPECIFICATIONS



3.1 IDENTIFICATION OF THE UNIT

1. Model and type of the unit.

2. Serial number.

3.2 WEIGHT, DIMENSIONS, OIL CAPACITY

Weight (dry): ±174.6 kg (385 lb.)

	T-model
Maximum length:	1015.6 mm (39.98”)
Maximum width:	571.8 mm (22.51”)
Maximum height:	1016.3 mm (40.01”)

Oil capacity

±18.9 l (5.0 US Gallon) without cooler and hydraulic lines.

Consult operator’s manual on applicable machine for system capacity.

3.3 TIGHTENING TORQUES

3.3.1 Torque specifications for lubricated or plated screw threads

NOM. SIZE	GRADE 5			
	FINE THREAD		COARSE THREAD	
	LBF - FT	[N.m]	LBF - FT	[N.m]
.2500	9 - 11	[12 - 15]	8 - 10	[11 - 14]
.3125	16 - 20	[22 - 27]	12 - 16	[16 - 22]
.3750	26 - 29	[35 - 39]	23 - 25	[31 - 34]
.4375	41 - 45	[56 - 61]	37 - 41	[50 - 56]
.5000	64 - 70	[87 - 95]	57 - 63	[77 - 85]
.5625	91 - 100	[123 - 136]	82 - 90	[111 - 122]
.6250	128 - 141	[174 - 191]	113 - 124	[153 - 168]
.7500	223 - 245	[302 - 332]	200 - 220	[271 - 298]

NOM. SIZE	GRADE 8			
	FINE THREAD		COARSE THREAD	
	LBF - FT	[N.m]	LBF - FT	[N.m]
.2500	11 - 13	[15 - 18]	9 - 11	[12 - 15]
.3125	28 - 32	[38 - 43]	26 - 30	[35 - 41]
.3750	37 - 41	[50 - 56]	33 - 36	[45 - 49]
.4375	58 - 64	[79 - 87]	52 - 57	[71 - 77]
.5000	90 - 99	[122 - 134]	80 - 88	[108 - 119]
.5625	128 - 141	[174 - 191]	115 - 127	[156 - 172]
.6250	180 - 198	[224 - 268]	159 - 175	[216 - 237]
.7500	315 - 347	[427 - 470]	282 - 310	[382 - 420]

NOM. SIZE	GRADE 8.8 or 9.8		GRADE 10.9	
	COARSE THREAD		COARSE THREAD	
	LBF - FT	[N.m]	LBF - FT	[N.m]
M8	15 - 20	[20 - 25]	22 - 26	[30 - 35]
M10	30 - 37	[40 - 50]	44 - 48	[60 - 65]
M12	50 - 55	[65 - 75]	74 - 81	[100 - 110]

3.3.2 Elastic stop nut torque

THREAD SIZE	LB - FT	[N . m]
1" - 20	150 - 200	[203.4 - 271.1]
1 1/4" - 18	200 - 250	[271.2 - 338.9]
1 1/2" - 18	300 - 350	[406.8 - 474.5]
1 3/4" - 18	400 - 450	[542.4 - 610.1]

3.3.3 "O" ring port plug torque chart

THREAD SIZE	LBF - FT	[N . m]
9/16" - 18	12 - 15	[16 - 20]
3/4" - 16	20 - 25	[27 - 34]

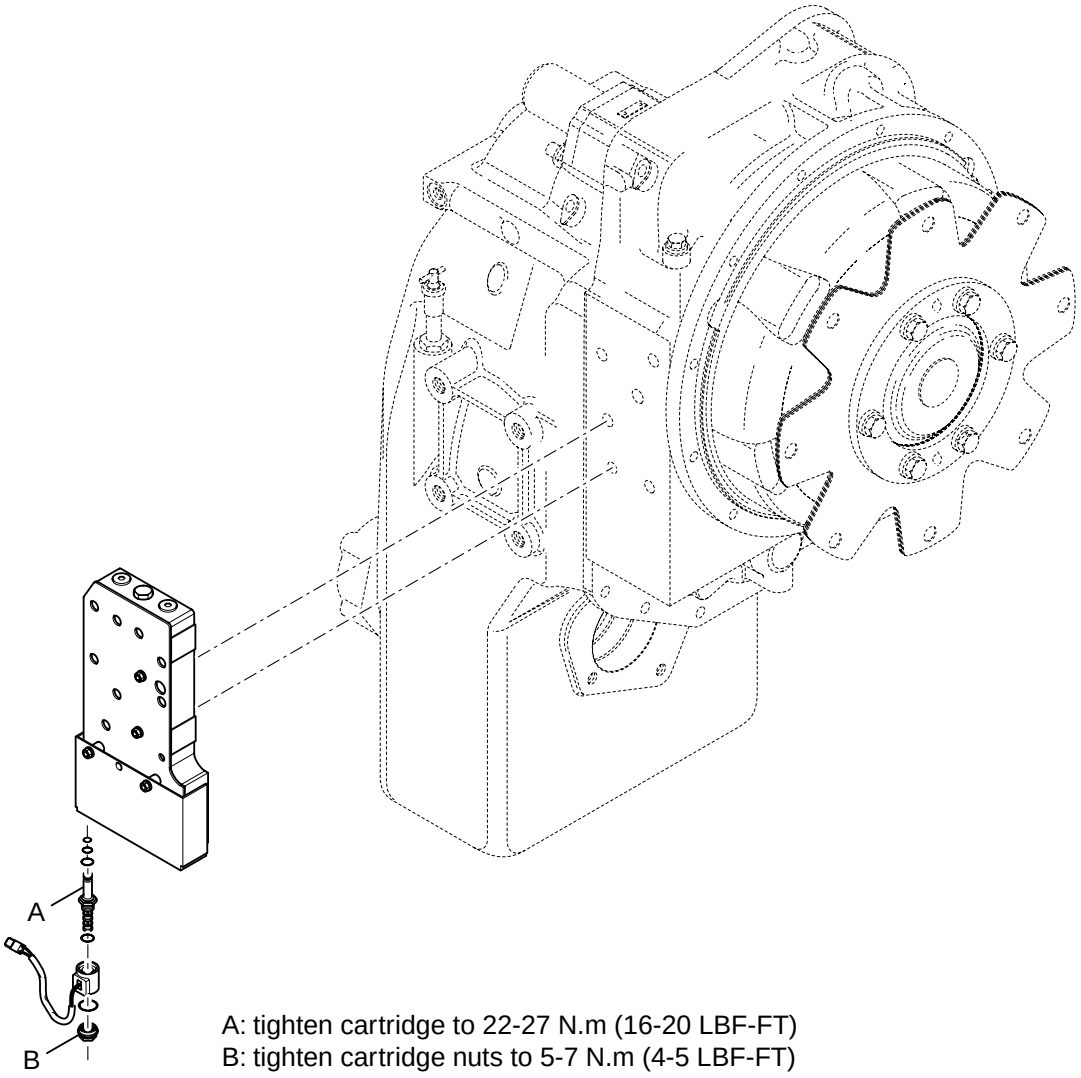
3.3.4 Pipe plug torque chart

THREAD NPTF	TORQUE	
	LBF - FT	[N.m]
1/16 - 27	5 - 7	[7 - 9]
1/8 - 27	7 - 10	[9 - 14]
1/4 - 18	15 - 20	[20 - 27]
3/8 - 18	25 - 30	[34 - 41]
1/2 - 14	30 - 35	[41 - 47]
3/4 - 10	40 - 45	[54 - 61]
1 - 11 1/2	55 - 50	[68 - 75]
1 1/4 - 11 1/2	60 - 65	[81 - 88]

3.3.5 Permanent metric plug torque chart

THREAD SIZE	TORQUE	
	LBF - FT	[N.m]
M18 x 1.5 6H	25-30	[34-41]
M18 x 1.5 6H	45-50	[61-68]

3.3.5 Coil and cartridge torque



A: tighten cartridge to 22-27 N.m (16-20 LBF-FT)
B: tighten cartridge nuts to 5-7 N.m (4-5 LBF-FT)

3.4 PRESSURE AND TEMPERATURE SPECIFICATIONS

- Normal operating temperature 70 - 120 °C (158 - 248 F) measured at temperature check port converter out (port 71 - **).
- Maximum allowed transmission temperature 120 °C (248 F).
- Transmission regulator pressure (*) - (neutral) - port 31 (**).

  - At 600 RPM min. 16.5 bar (240 PSI) minimum.

  - At 2200 RPM: 19.3 bar (280 PSI) maximum.

- Pump flow (*)

  - At 1800 RPM in neutral: 54.9 l/min. minimum (14.5 GPM).

- Clutch pressures (*)

  - 1st clutch: port 41 (**).

  - 2nd clutch: port 42 (**).

  - 3rd clutch: port 43 (**).

  - Forward clutch: port 45 (**).

  - Reverse clutch: port 46 (**).

  At 2000 RPM :

  - 16.5 - 19.3 bar (240 - 280 PSI) clutch activated.

  - 0 - 0.2 bar (0 - 3 PSI) clutch released.

- Filter bypass valve set at 1.5 - 1.7 bar (*) (22 - 24 PSI).
- Lube pressure (*) (port 33) 0.7 - 1.4 bar (10 - 20 PSI) at 54.9 l/min. (14.5 GPM) pump flow (±1800 RPM).
- Safety valve: cracking pressure (*) 8.2 - 12.1 bar (120 - 175 PSI).
- Converter out pressure (*) (port 32) 1.7 bar min. (25 PSI) at 2000 RPM and max. 4.8 bar (70 PSI) at no load governed speed.

(*) All pressures and flows to be measured with oil temperature of 82-93 °C (180-200 F)

(**) Refer to section 7 “Troubleshooting” for check port identification.

3.5 ELECTRICAL SPECIFICATIONS

- Solenoid (forward, reverse, 1st and 2nd).

  Coil resistance:

  - 12V: 9.79 Ω ±0.5 Ω.
  - 24V: 39.3 Ω ±2 Ω.

- Speed sensor:
  - Type: magneto resistive sensor.
  - Sensing distance: 0 - 1.8 mm (0” - 0.07”).
  - Sensor signal: generates a square current with a fixed amplitude changing between 7 and 14 mA.

3.6 HYDRAULIC COOLER AND FILTER LINE SPECIFICATIONS

- Minimum 19 mm (.75”) internal diameter for lines and fittings.
- Suitable for operation from ambient to 120 °C (248 F) continuous operating temperature.
- Must withstand 20 bar (290 PSI) continuous pressure and with 40 bar (580 PSI) intermittent surges.
- Conform SAE J1019 and SAE J517, 100RI.

4. MAINTENANCE

4.1 OIL SPECIFICATION

4.1.1 Recommended lubricants

1.	Caterpillar	TO-4.
2.	John Deere	J20 C, D.
3.	Military	MIL-PRF-2104G.
4.	Allison	C-4.
5.	Dexron*	II Equivalent - See note below.

Note

DEXRON* II EQUIVALENT IS ACCEPTABLE; HOWEVER IT IS NOT COMPATIBLE WITH TORQUE CONVERTERS OR TRANSMISSIONS EQUIPPED WITH GRAPHITIC FRICTION MATERIAL CLUTCH PLATES.

Caution

DEXRON* III, ENGINE OIL OR GL-5 OILS ARE NOT RECOMMENDED.

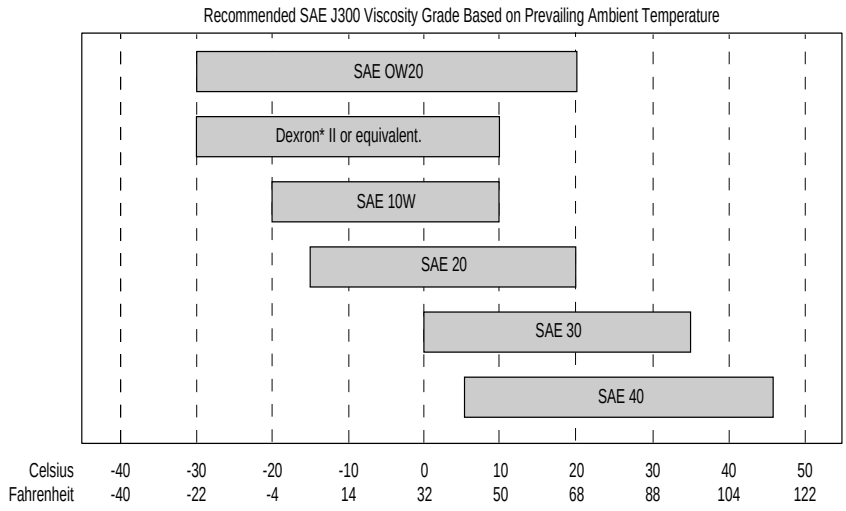
PREFERRED OIL VISCOSITY

It is recommended that the highest viscosity monograde lubricant available be used for the anticipated ambient temperature. Typically this will be a CAT TO-4 qualified lubricant. When large swings in ambient temperature are probable, J20 C, D multigrades are recommended. Multigrade lubricants should be applied at the lower viscosity rating for the prevailing ambient temperature, i.e. a 10W20 should be used where a 10W monograde is used. If a C-4 multigrade is used in stead of J20 lubricant it is recommended that the viscosity span no more than 10 points, i.e. 10W20.

Caution

SYNTHETIC LUBRICANTS ARE APPROVED IF QUALIFIED BY ONE OF THE ABOVE SPECIFICATIONS.
OIL VISCOSITY GUIDELINES APPLY, BUT SYNTHETIC MULTIGRADES MAY SPAN MORE THAN 10 POINTS.

FOR FIRE RESISTANT FLUID RECOMMENDATIONS PLEASE CONTACT ***SPICER OFF-HIGHWAY PRODUCTS***.


Recommended SAE J300 Viscosity Grade Based on Prevailing Ambient Temperature
SAE OW20
Dexron* II or equivalent.
SAE 10W
SAE 20
SAE 30
SAE 40
Celsius -40 -30 -20 -10 0 10 20 30 40 50
Fahrenheit -40 -22 -4 14 32 50 68 88 104 122

SUMP PREHEATERS

Preheat the transmission fluid to the minimum temperature for the oil viscosity used before engine start up.

NORMAL OIL CHANGE INTERVAL

Drain and refill system every 1000 hours for average environmental and duty cycle conditions. Severe or sustained high operating temperature or very dusty atmospheric conditions will result in accelerated deterioration or contamination. Judgement must be used to determine the required change intervals for extreme conditions.

EXTENDED OIL CHANGE INTERVAL

Extended oil service life may result when using synthetic fluids. Appropriate change intervals should be determined for each transmission by measuring oil oxidation and wear metals, over time, to determine a baseline. Wear metal analysis can provide useful information but a transmission should not be removed from service based solely on this analysis.

FILTERS

Service oil filters element every 500 hours under normal environmental and duty cycle conditions.

*Dexron is a registered trademark of GENERAL MOTORS CORPORATION.

4.2 MAINTENANCE INTERVALS

4.2.1 Daily

Check oil level daily with engine running at idle (600 RPM) and oil at 82 - 93 °C (180-200 F).

Maintain oil level at full mark.

4.2.2 Normal drain period

Normal drain period and oil filter element change are for average environment and duty cycle condition.

Severe or sustained high operating temperature or very dusty atmospheric conditions will cause accelerated deterioration and contamination.

For extreme conditions judgement must be used to determine the required change intervals.

Every 500 hours

Change oil filter element.

Every 1000 hours

Drain and refill system as follows (Drain with oil at 65 - 93 °C (150 - 200 F)):

1. Drain transmission.
2. Remove and discard filter. Install new filter.
3. Refill transmission to FULL mark.
4. Run engine at 500 - 600 RPM to prime convertor and lines.
5. Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot 82.2 - 93.3 °C (180- 200 F) make final oil level check and adjust if necessary to bring oil level to FULL mark.

Note

IT IS RECOMMENDED THAT OIL FILTER BE CHANGED AFTER 100 HOURS OF OPERATION ON NEW, REBUILT OR REPAIRED UNIT.

4.3 SERVICING MACHINE AFTER COMPONENTS OVERHAUL

The transmission, torque converter, and its allied hydraulic system are important links in the driveline between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other. Therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered complete.

After the overhauled or repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
3. Replace oil filter element.
4. The oil cooler must be thoroughly cleaned. The cooler should be “back flushed” with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, cooler assembly should be removed from machine for cleaning, using oil, compressed air, and steam cleaner for that purpose.

IMPORTANT

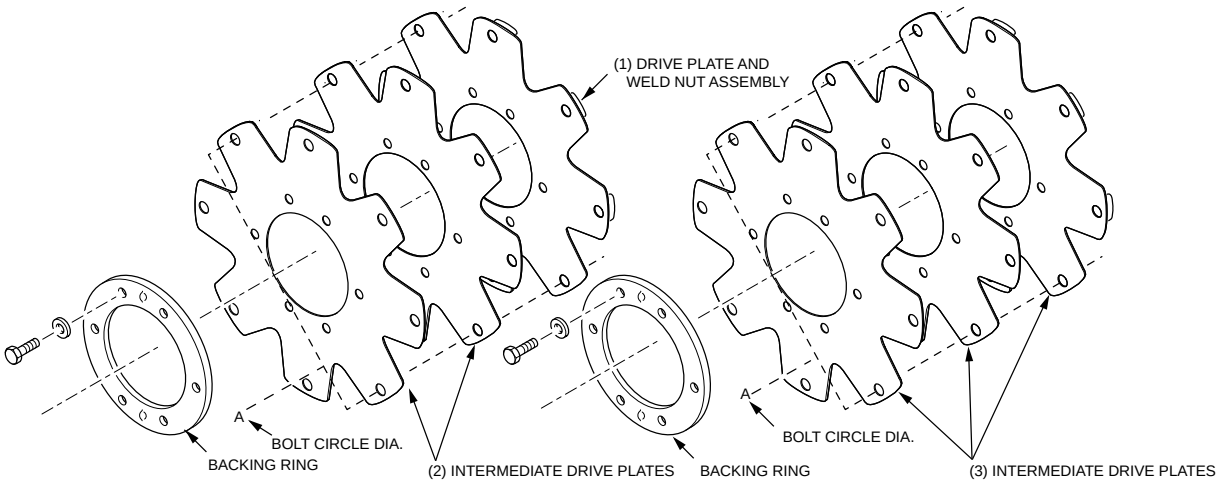
DO NOT USE FLUSHING COMPOUNDS FOR CLEANING PURPOSES.

5. Reassemble all components and use only type oil (See chapter 4.1.1 “Recommended lubricants”). Fill the transmission through filler opening until fluid comes up to FULL mark on transmission dipstick.
   - Remove filler plug and fill oil until FULL mark.
   - Run engine two minutes at 500 - 600 RPM to prime torque convertor and hydraulic lines.
   - Recheck level of fluid in transmission with engine running at idle (500 - 600 RPM).
   - Add quantity necessary to bring fluid level to LOW mark on dipstick.
   - Recheck with hot oil 82.2 - 93.3 °C (180 - 200 F).
   - Adjust oil level to FULL mark on dipstick.
6. Recheck all drain plugs, lines, connections, etc…., for leaks and tighten where necessary.

5. INSTALLATION DETAILS

5.1 CONVERTER DRIVE COUPLING

Measure the “A” dimension (bolt circle diameter) and order drive plate kit listed below. Note three (3) kits have two (2) intermediate drive plates and one (1) drive plate and weld nut assembly. Three (3) kits with three intermediate drive plates.



“A” Dimension (Bolt circle diameter)

- 11.380” (288.900 mm) diameter
  Kit No. 814978.
- 13.125” (333.38 mm) diameter
  Kit No. 814977.
- 13.500” (342.90 mm) diameter
  Kit No. 814975.

Each kit will include the following parts:

- 2 Intermediate drive plates.
- 1 Drive plate and weld nut assembly.
- 1 Backing ring.
- 6 Mounting screws.
- 6 Lockwashers.
- 1 Instruction sheet.

“A” Dimension (Bolt circle diameter)

- 11.380” (288.900 mm) diameter
  Kit No. 814979.
- 13.125” (333.38 mm) diameter
  Kit No. 814980.
- 13.500” (342.90 mm) diameter
  Kit No. 814981.

Each kit will include the following parts:

- 3 Intermediate drive plates.
- 1 Backing ring.
- 6 Mounting screws.
- 6 Lockwashers.
- 1 Instruction sheet.

Position drive plate and weld nut assembly on torque converter assembly with weld nuts toward converter. Align intermediate drive plates and backing plate with holes in torque converter assembly.

Note

TWO DIMPLES 180° APART IN BACKING RING MUST BE OUT TOWARD ENGINE FLYWHEEL (HOLLOW SIDE FACING TORQUE CONVERTER ASSEMBLY). INSTALL CAP SCREWS AND LOCKWASHERS. TIGHTEN CAP SCREWS TORQUE 40 - 50 N.M. (30 - 37 LBF. FT.).

5.2 TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent.
2. Check engine flywheel & housing for conformance to standard SAE No. 3 per SAE J927 and J1033 tolerance specifications for pilot bore size, pilot bore runout and mounting face flatness. Measure and record engine crankshaft end play (Fig. 1).
3. Install two 63,50 mm (2.50") long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole (Fig. 2).

*4. Install a 101,60 mm (4.00") long drive plate locating stud .3750-24 fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in step No. 3.

5. Rotate the transmission torque converter to align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in step No. 3. Locate transmission on flywheel housing.

   Aligning drive plate to flywheel and transmission to flywheel housing guide studs. Install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.

*6. Remove drive plate locating stud.

7. Install drive plate attaching screw and washer. Snug screw but **do not tighten**. Some engine flywheel housings have a hole located on the flywheel housing circumference in line with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven (7) flywheel to drive plate attaching screws. Snug screws but do not tighten. After all eight (8) screws are installed. Torque each one 35 to 39 N.m. (26- 29ft.lbs.). This will require tightening each screw and rotating the engine flywheel until the full amount of eight (8) screws have been tightened to specified torque.
8. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within 0,025 mm (0.001") of the end play recorded in step No. 2.

* Does not apply to units having 3 intermediate drive plates. See Fig.4.

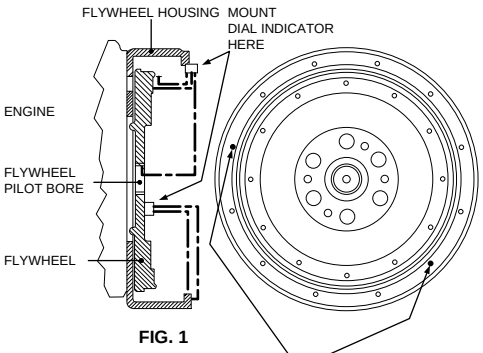


FIG. 1

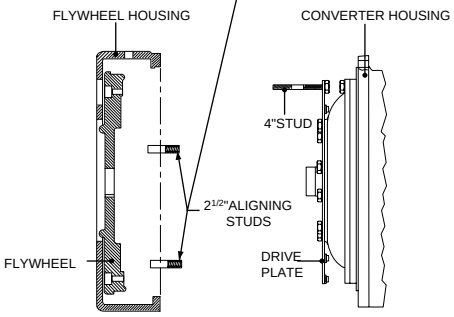


FIG. 2

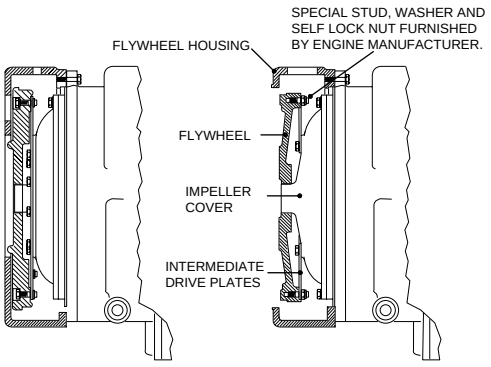


FIG. 3 **FIG.4**

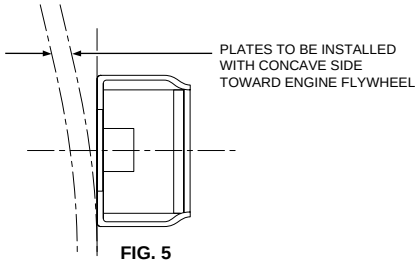
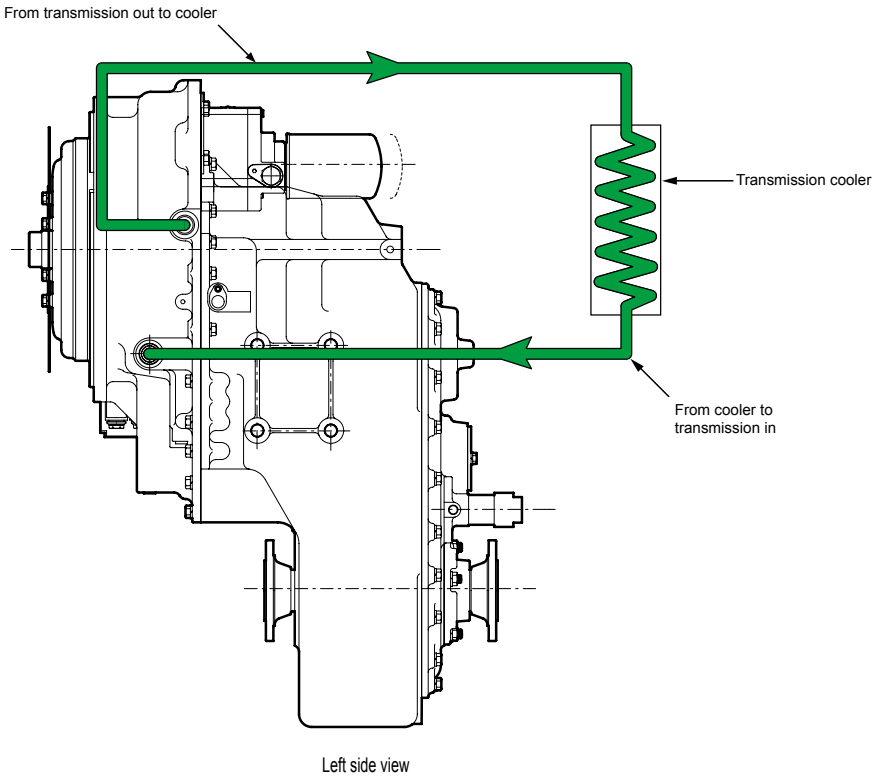
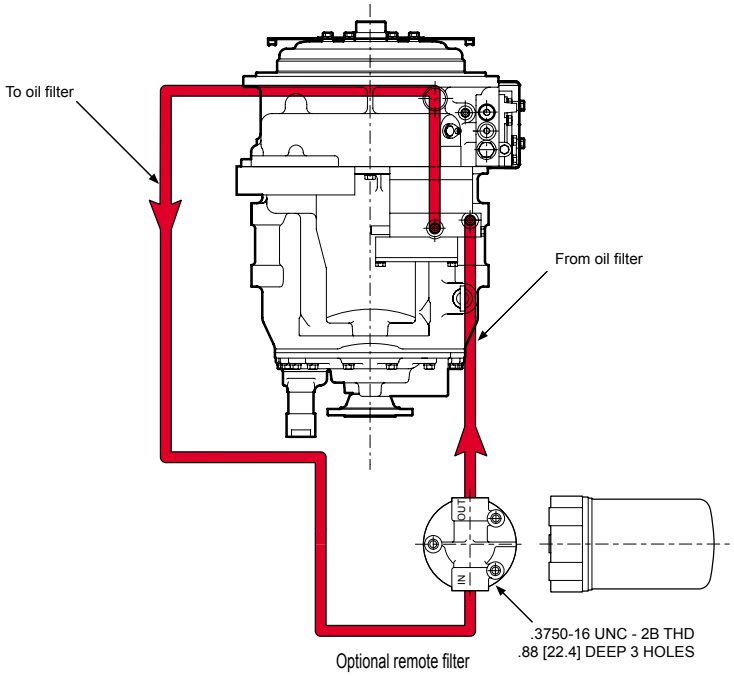


FIG. 5

5.3 EXTERNAL PLUMBING



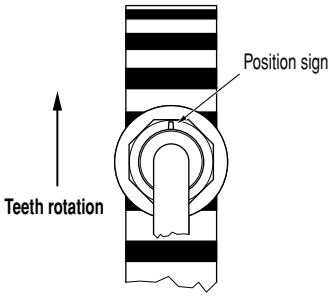
5.3.1 Optional: remote filter



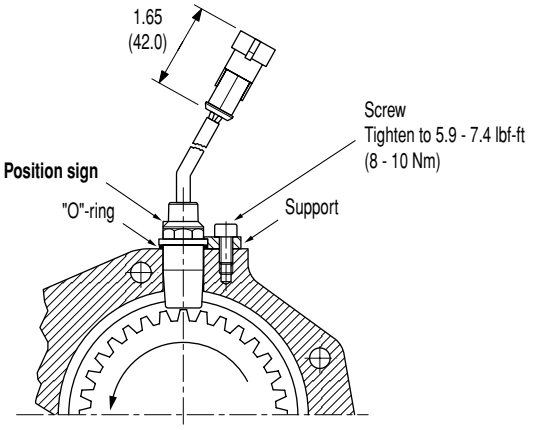
5.3.2 Cooler & filter lines specifications

- Minimum 19 mm (.75 inch) internal diameter for lines and fittings.
- Suitable for operation from ambient to 120 °C (248 F) continuous operating temperature.
- Must withstand 20 bar (290 psi) continuous pressure and with 40 bar (580 psi) intermittent surges.
- Conform SAE J1019 and SAE J517,100RI.

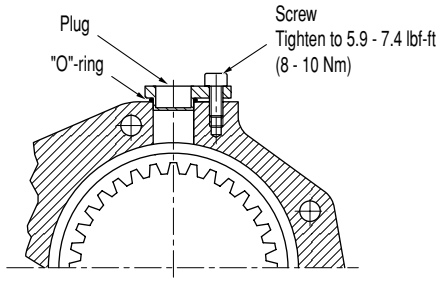
5.4 SPEED SENSOR INSTALLATION



On the sensor body there is a small plastic triangular position sign. Make sure the position sign on the sensor points as shown below in the direction of the movement of the gearteeth (Teeth rotation as shown).

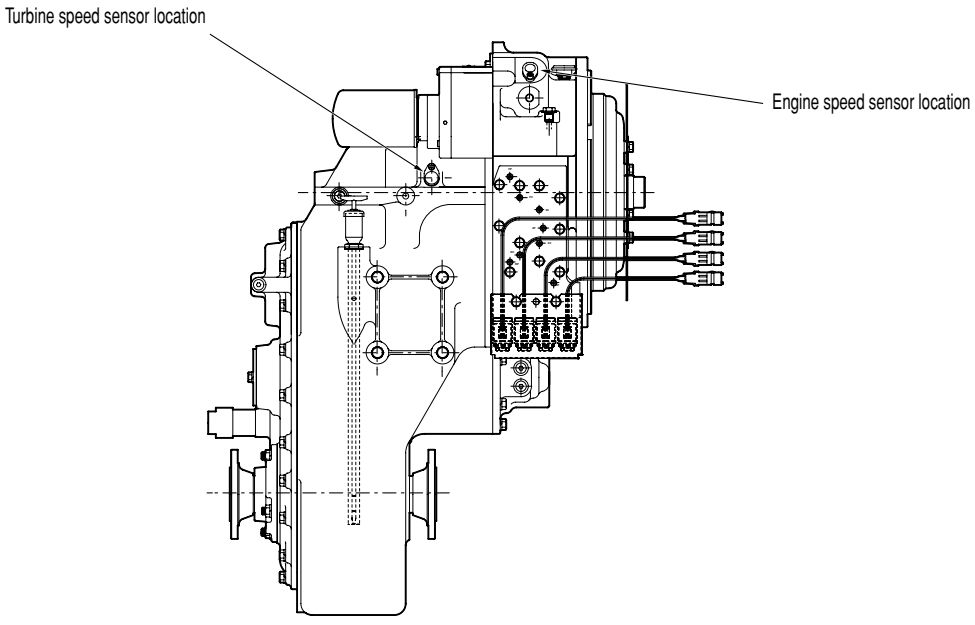


Sensor installed

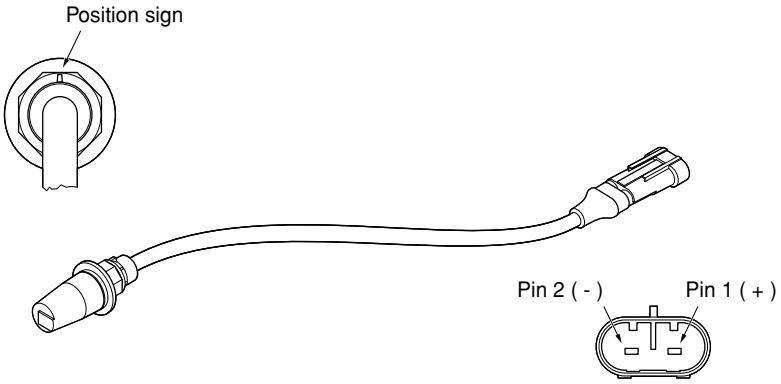


Hole plugged

Sensor position on transmission



5.4 SPEED SENSOR INSTALLATION (Continued)



The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 mA and 14 mA.

The sensor has an integrated AMP superseal 2 pin connector.
The two pins are numbered 1 and 2.

Following table shows the relation between wire colour, pin number and connection.

COLOUR	PIN NUMBER	FUNCTION	CONNECTION
BROWN	1	Current input	Hot wire
BLUE	2	Current output	Ground wire

Note

THE SENSOR WIRES HAVE A POLARITY.

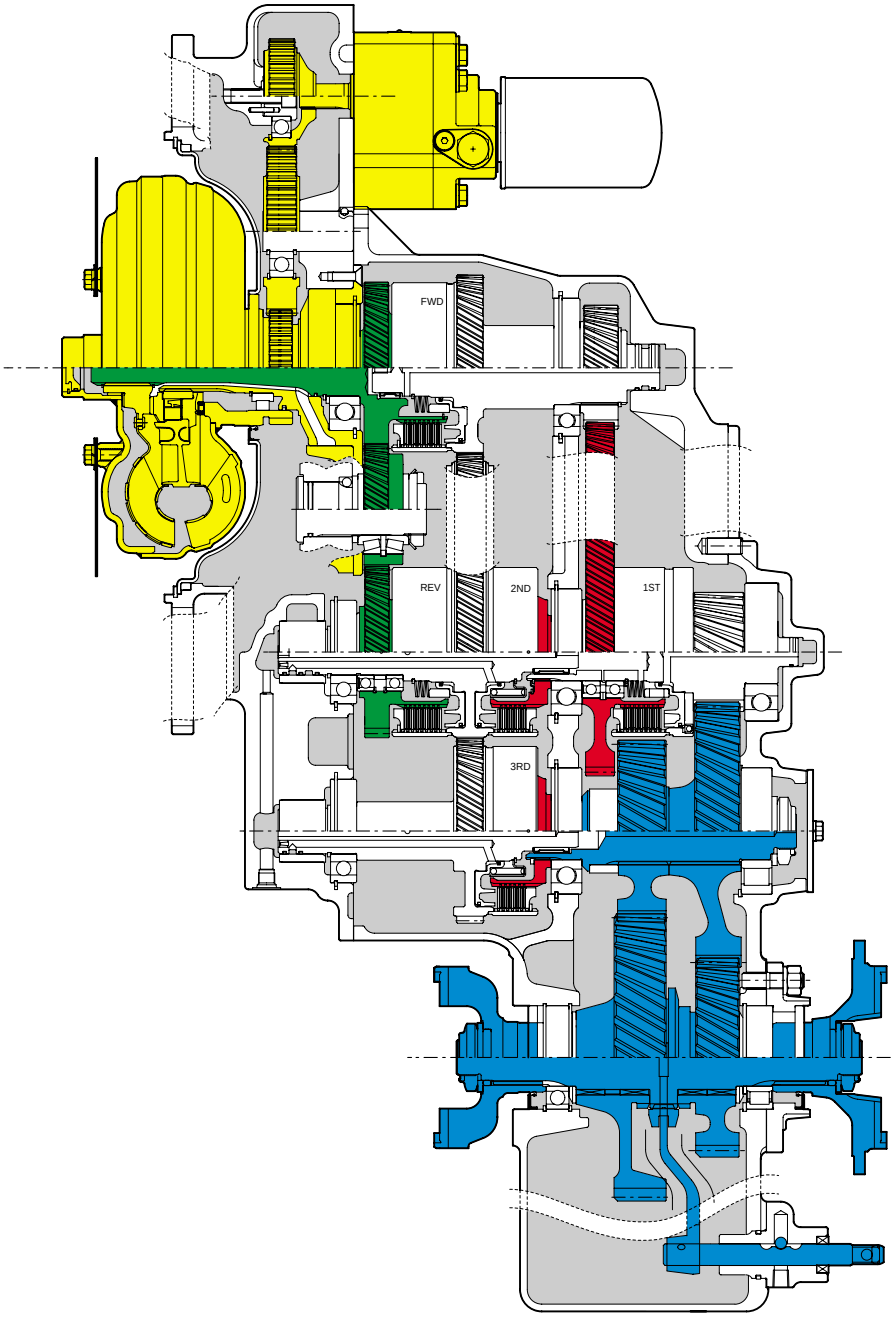
BE SURE TO CORRECTLY OBSERVE SENSOR POLARITIES, AS WRONG CONNECTIONS WILL DEACTIVATE THE SENSOR !

6. OPERATION OF THE TRANSMISSION

6.1 THE TRANSMISSION ASSEMBLY

Basically the transmission is composed of five main assemblies:

1. The converter, pump drive section and pressure regulating valve.
2. The input shaft and directional clutches.
3. The range clutches.
4. The output section.
5. The transmission control valve.



6.1.1 The converter, pump drive section and pressure regulating valve

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.

This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump, that picks up fluid at its centre and discharges it at the outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft of the torque converter. This element receives fluid at its outer diameter and discharges it at its centre.

The reaction member of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element. This recirculation will make the converter to multiply torque.

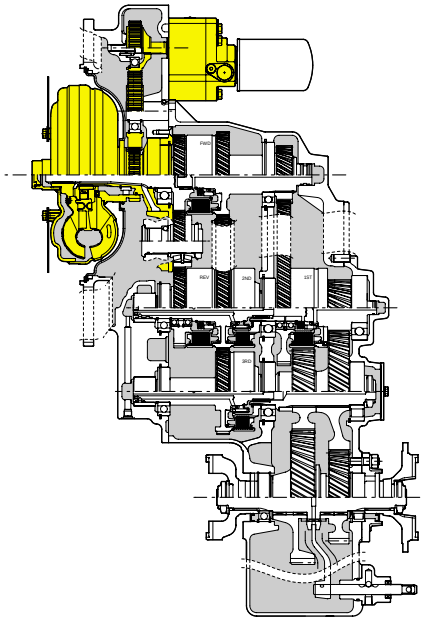
The torque multiplication is function of the blading (impeller, turbine and reaction member) and the converter output speed (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).

Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing.

The hydraulic pump is connected with the pump drive gear. This pump drive gear is driven by the impeller hub gear. Since the impeller hub gear is connected with the impeller cover, the pump speed is in direct relation with the engine speed.

Note

THE PRESSURE REGULATOR VALVE AND SAFETY VALVE ARE MOUNTED BEHIND THE FILTER, IN THE FILTER ADAPTER HOUSING.



THE CONVERTER, PUMP DRIVE SECTION AND PRESSURE REGULATING VALVE

6.1.2 The input shaft and directional clutches

The turbine shaft driven from the turbine transmits power to the forward or reverse clutch.

These clutches consist of a drum with internal splines and a bore to receive a hydraulic actuated piston. The piston is oil tight by the use of sealing rings. The steel discs with external splines, and friction discs with internal splines, are alternated until the required total is achieved.

A back-up plate is then inserted and secured with a retainer ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, the solenoid will direct oil under pressure through tubes and passages to the selected clutch shafts.

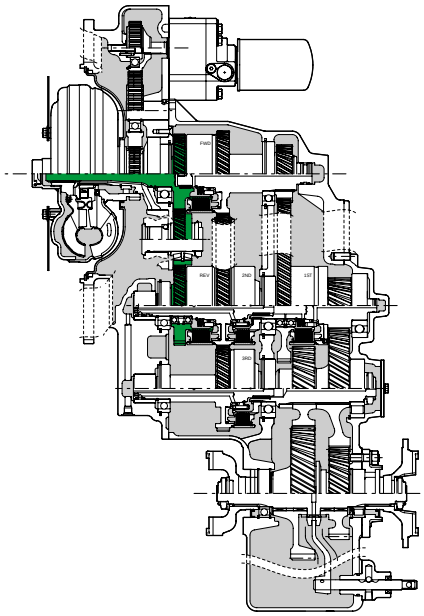
Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

Pressure of the oil forces the piston and discs against the back-up plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.

When the clutch is released, a return spring will push the piston back and oil will drain back via the shift spool, the bleed valve or holes in the clutch piston into the transmission sump.

These bleed valves will only allow quick escape of oil when the pressure to the piston is released.

As an option the engagement of the directional clutches can be modulated. This means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive. The modulation is done hydraulically.



THE INPUT SHAFT AND DIRECTIONAL CLUTCHES

6.1.3 The range clutches

Once a directional clutch is engaged power is transmitted to the range clutches (1st, 2nd or 3rd).
Operation and actuation of the range clutches is similar to the directional clutches.
The engagement of the range clutches are not modulated.

6.1.4 The output section

With a range clutch engaged, power is finally transmitted to the output shaft.
Output rotation is opposite as the engine rotation when the forward clutch is engaged.

A front and/or rear axle disconnect is optional and is located on the output shaft. The drive to the front and/or rear axle can be disconnected or connected by manual shifting.

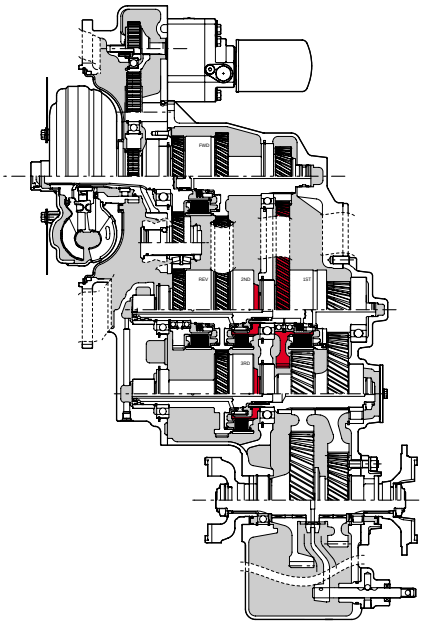
Note

TO ENGAGE OR DISENGAGE THE AXLE DISCONNECT, THE VEHICLE IS NOT ALLOWED TO DRIVE, BUT NEEDS TO BE AT STANDSTILL.

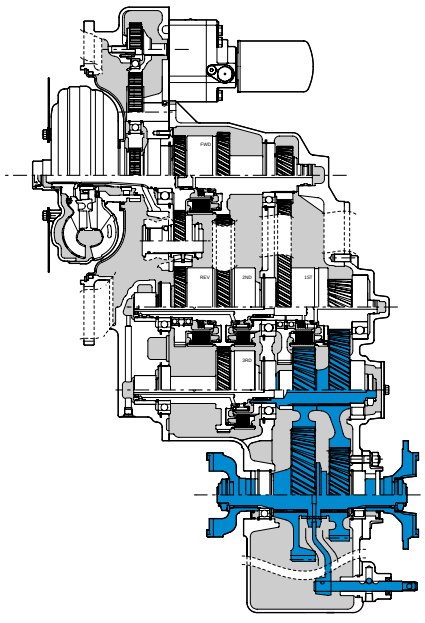
The 6-speed range shift transmission has a manual shifting to select low or high range.

Note

TO SHIFT THE RANGE SHIFT, THE VEHICLE IS NOT ALLOWED TO DRIVE, BUT NEEDS TO BE AT STANDSTILL.



THE RANGE CLUTCHES



THE OUTPUT SECTION

6.1.5 The transmission controls (refer to hydraulic diagram)

The transmission is controlled by the control valve. The control valve assembly is mounted directly on the side of the converter housing. The function of the control valve assembly is to direct oil under pressure to the desired directional and speed clutch. A provision is made on certain models for inching or declutch when the brakes are applied.
This is accomplished through use of a brake actuated valve.

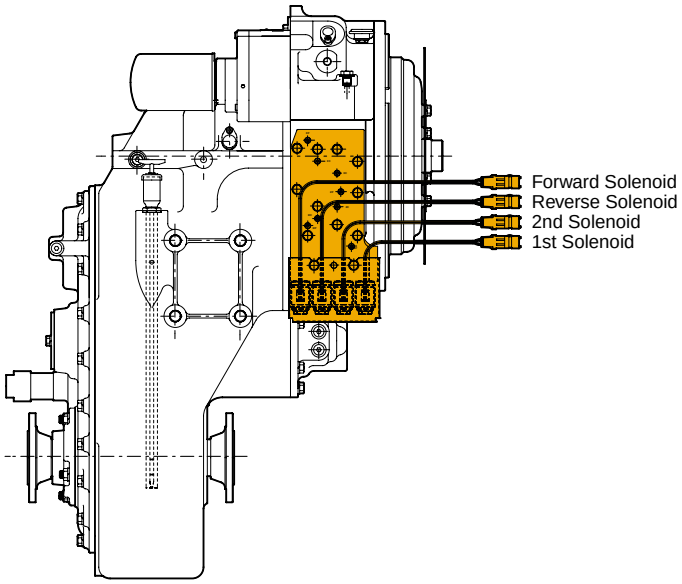
The control valve has 4 solenoids and 4 shift spools.

Operation of the valve

Forward can be selected by activating the forward solenoid. The forward solenoid will then allow pilot pressure to move the forward shift spool. Due to this movement of the shift spool the forward clutch is fed with oil pressure.

When the reverse solenoid is activated, pilot pressure will move the reverse shift spool. The reverse clutch will be fed with oil pressure.

The shift spools of forward and reverse are located opposite each other separated by a return spring. This ensures that only one direction can be selected.



THE TRANSMISSION CONTROLS

Selection of range

If the range solenoids 1st and 2nd are activated, regulated pressure is fed through the shift spools to the 1st clutch.

If the range solenoid 2nd is activated, regulated pressure is fed through the shift spools to the 2nd clutch.

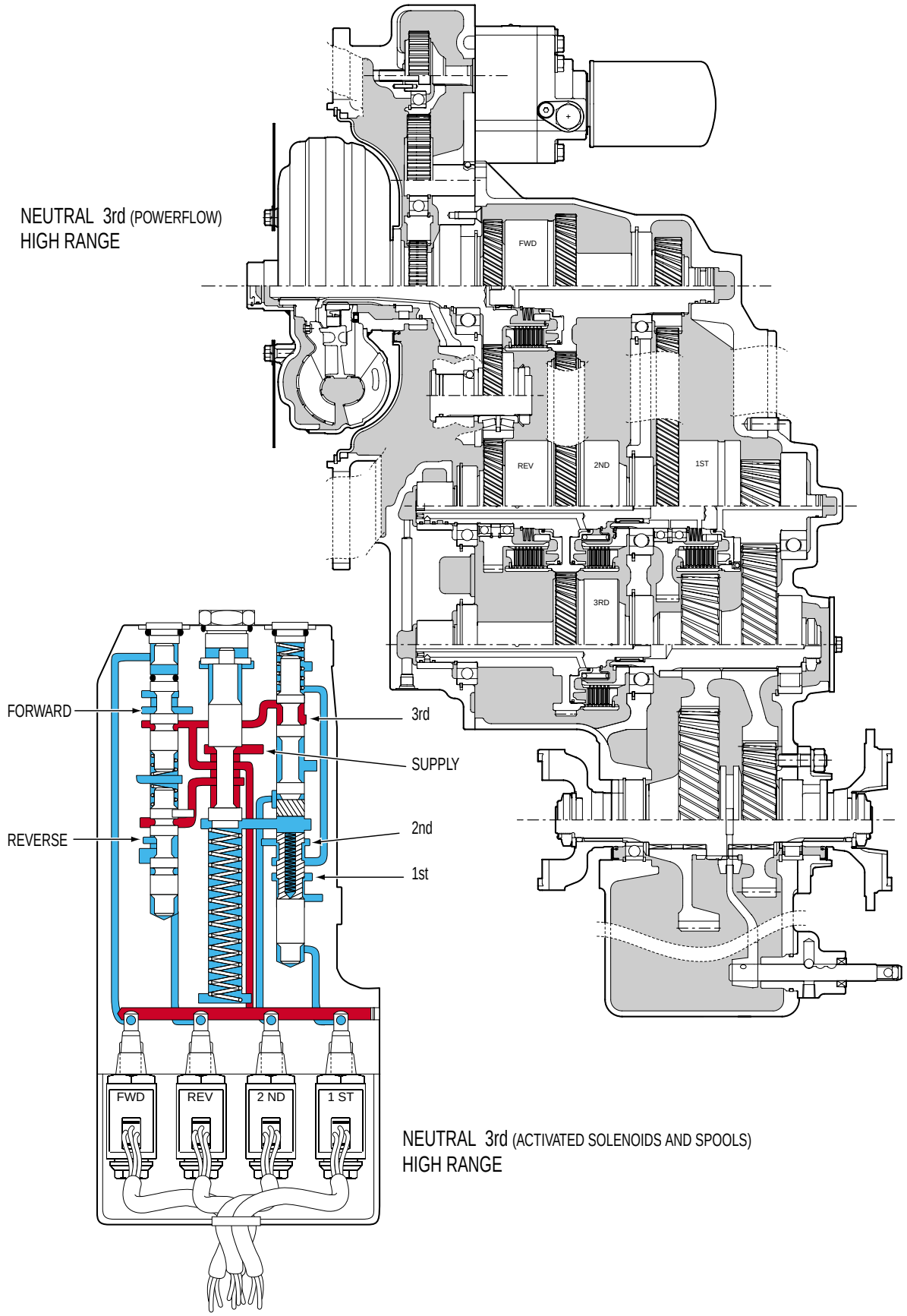
If no range solenoids are activated, the regulated pressure is fed to the 3rd clutch.

6.2 ELECTRIC SOLENOID CONTROLS

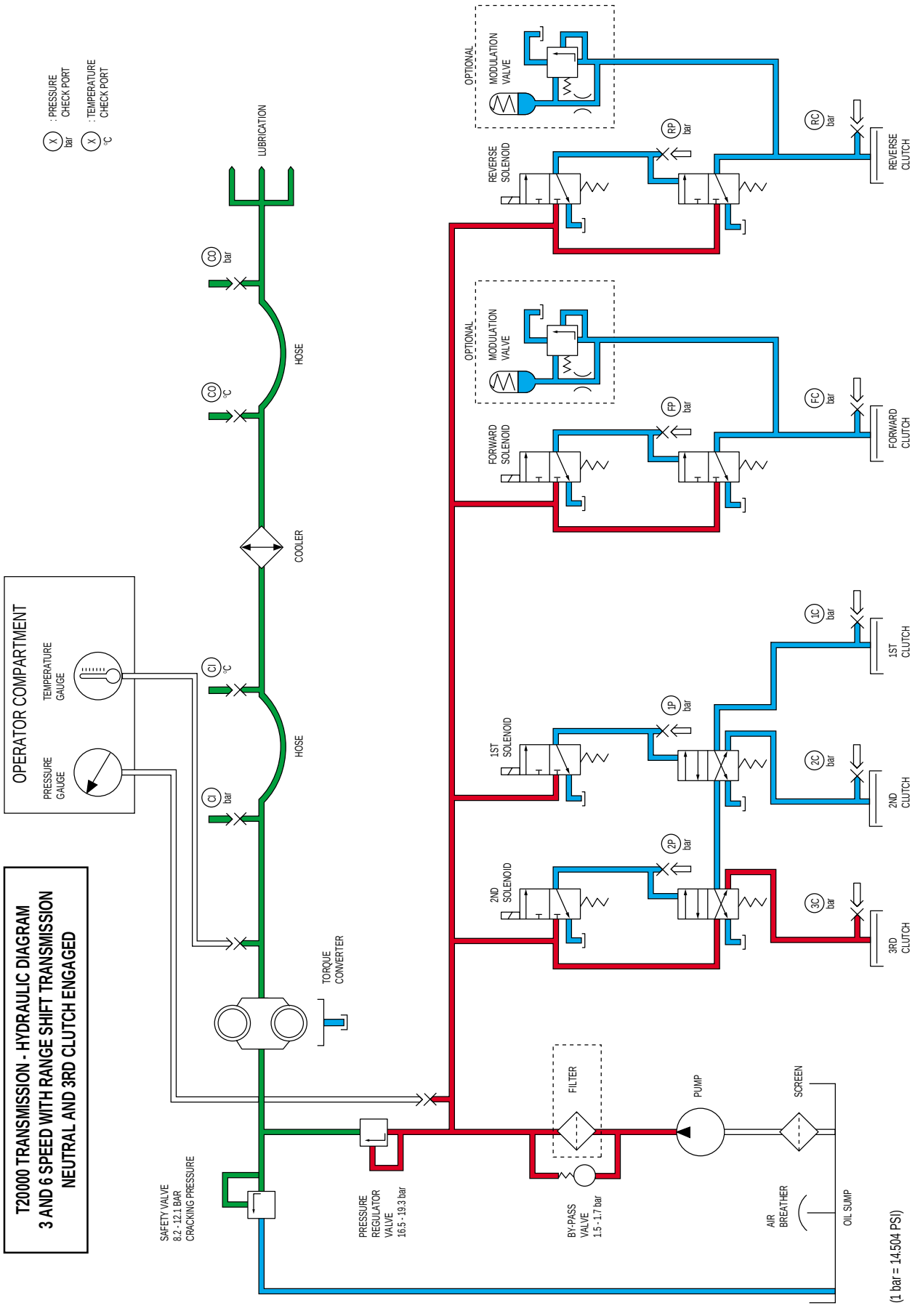
Transmission gear	Activated solenoids	Activated clutches
Forward 3	Forward	Forward, 3rd
Forward 2	Forward, 2nd	Forward, 2nd
Forward 1	Forward, 1st, 2nd	Forward, 1st
Neutral 3	-	3rd
Neutral 2	2nd	2nd
Neutral 1	1st, 2nd	1st
Reverse 3	Reverse	Reverse, 3rd
Reverse 2	Reverse, 2nd	Reverse, 2nd
Reverse 1	Reverse, 1st, 2nd	Reverse, 1st

6.3 POWERFLOWS, ACTIVATED SOLENOIDS AND HYDRAULIC CIRCUIT

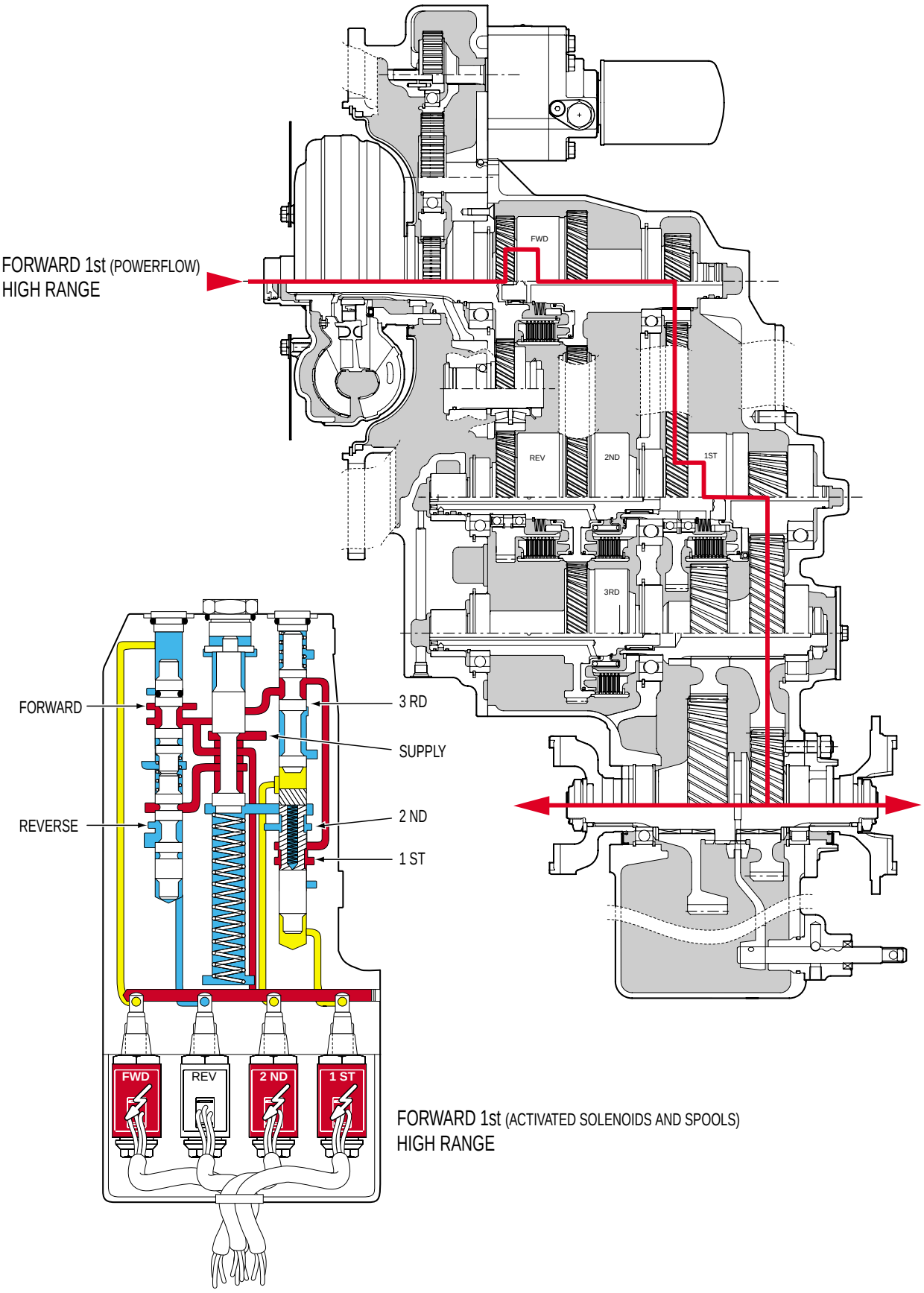
6.3.1 Neutral, 3rd clutch engaged and high range selected



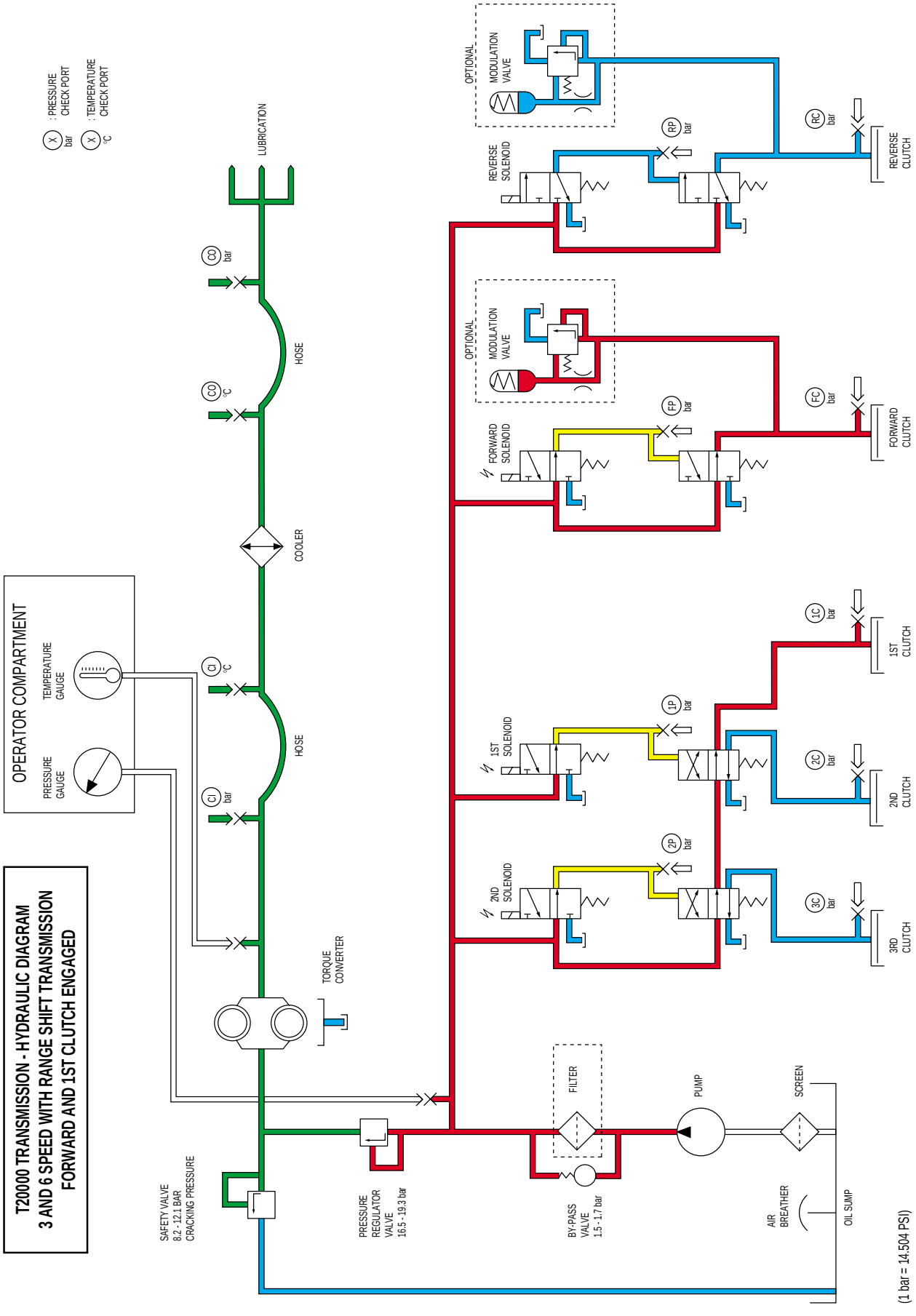
6.3.1 Neutral, 3rd clutch engaged and high range selected (continued)



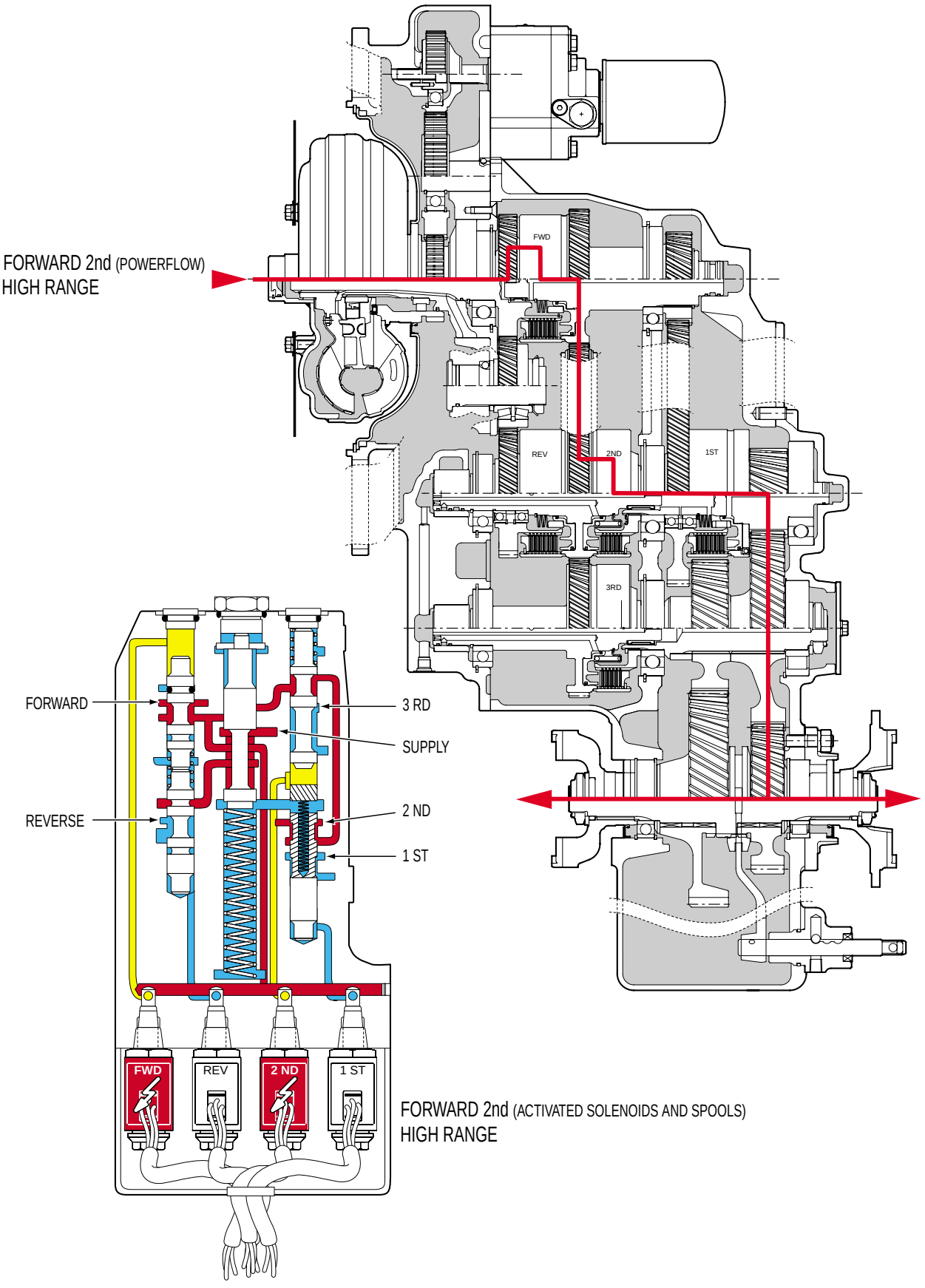
6.3.2 Forward 1st speed and high range selected



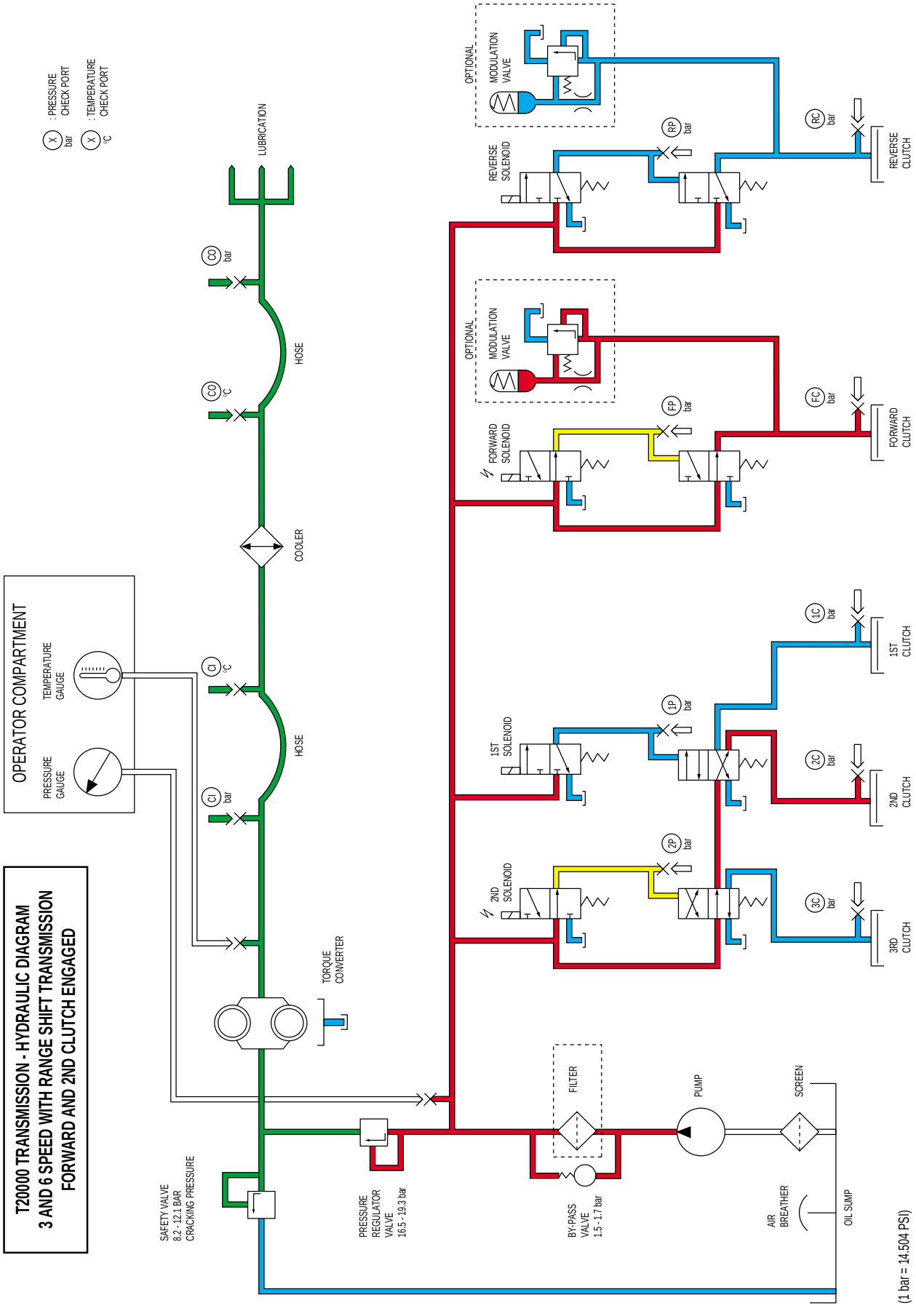
6.3.2 Forward 1st speed and high range selected (continued)



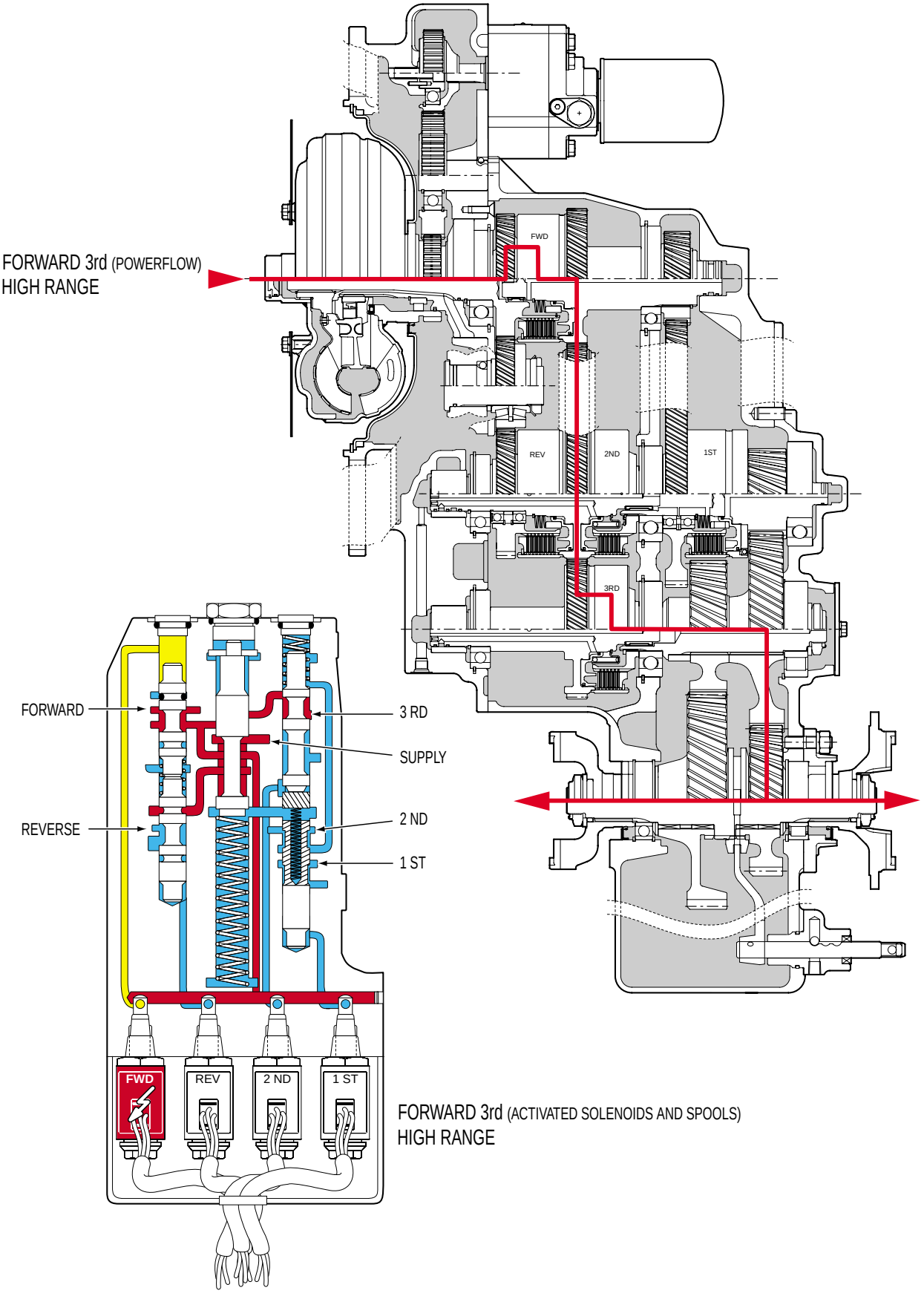
6.3.3 Forward 2nd speed and high range selected



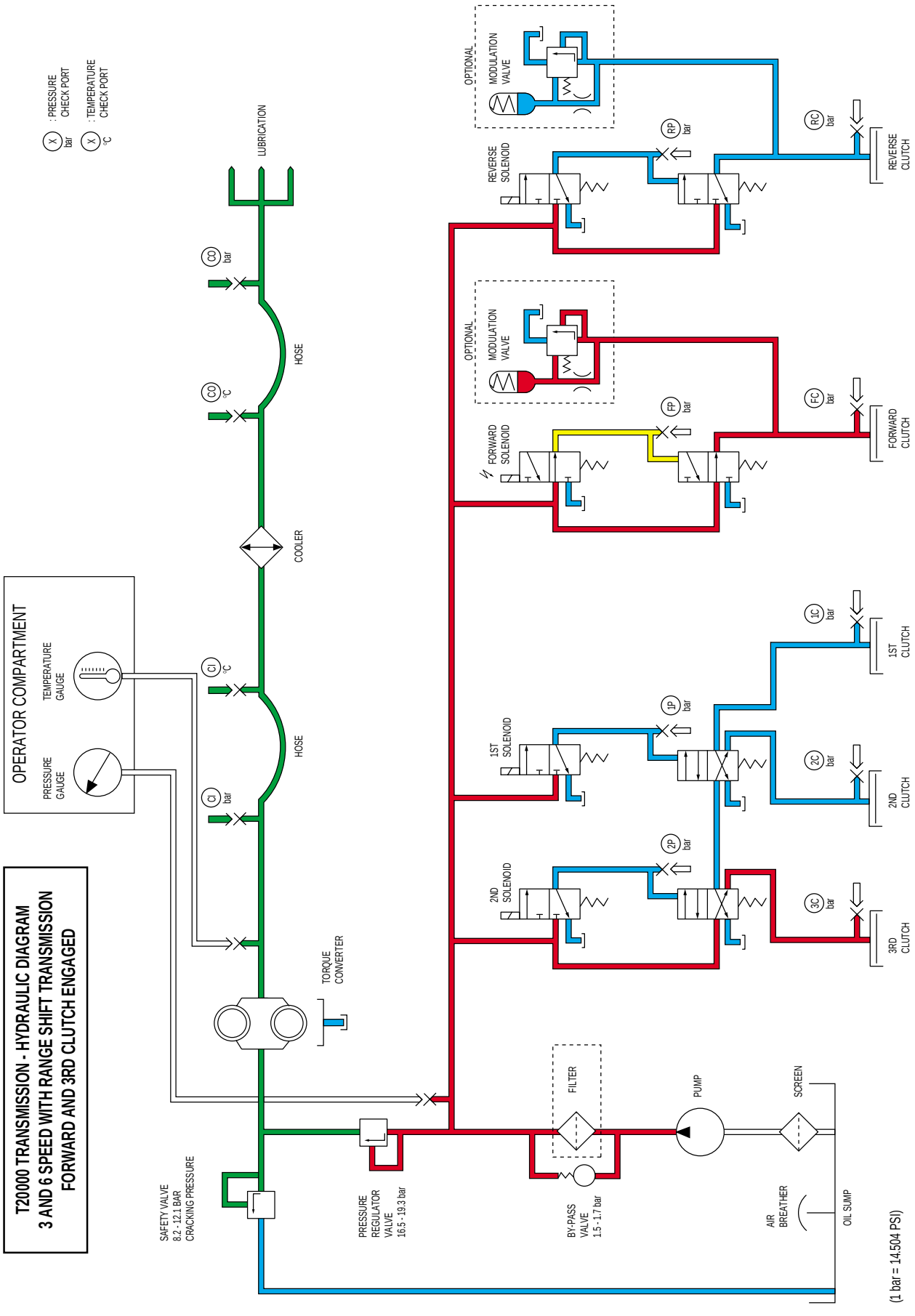
6.3.3 Forward 2nd speed and high range selected (continued)



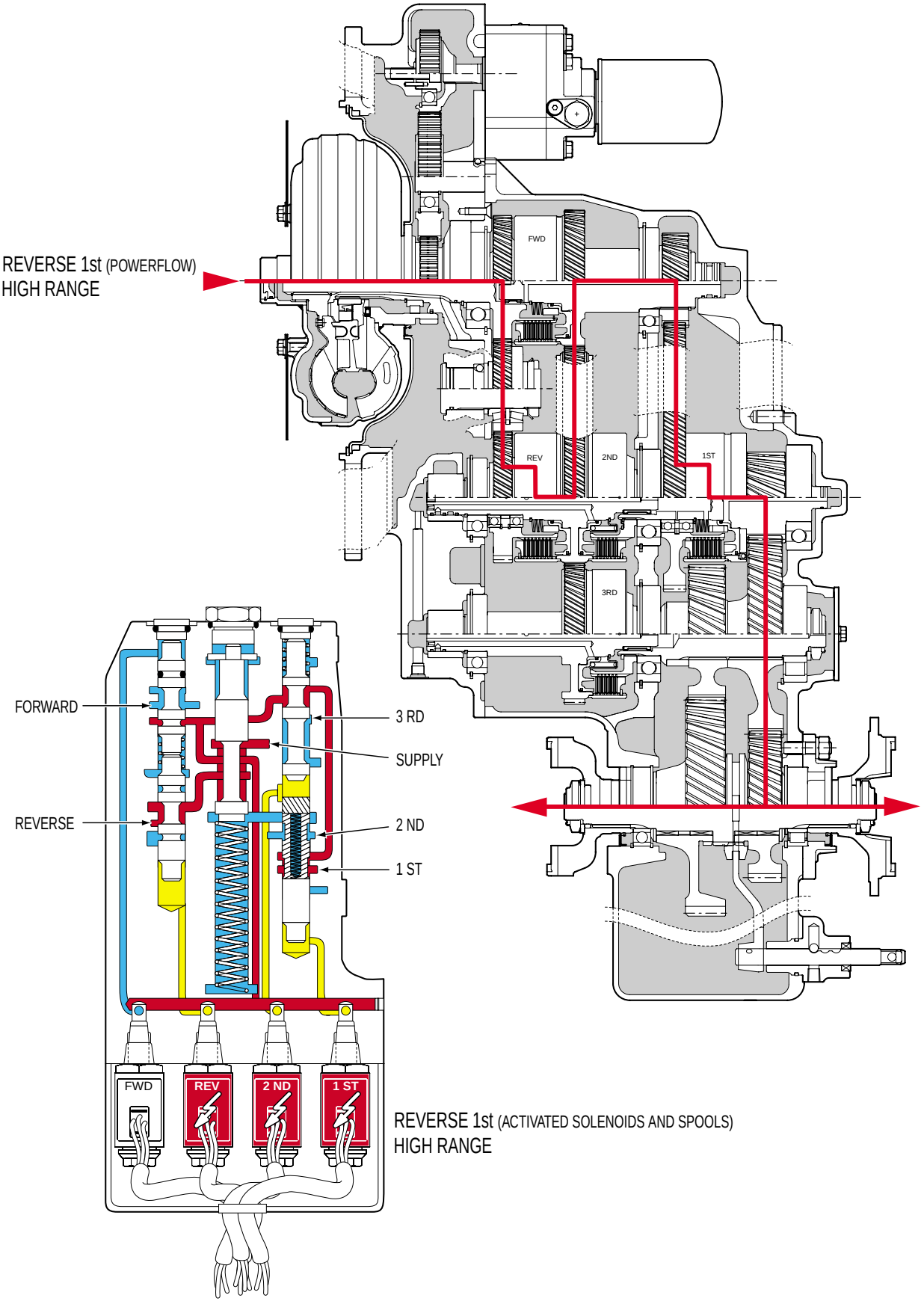
6.3.4 Forward 3rd speed and high range selected



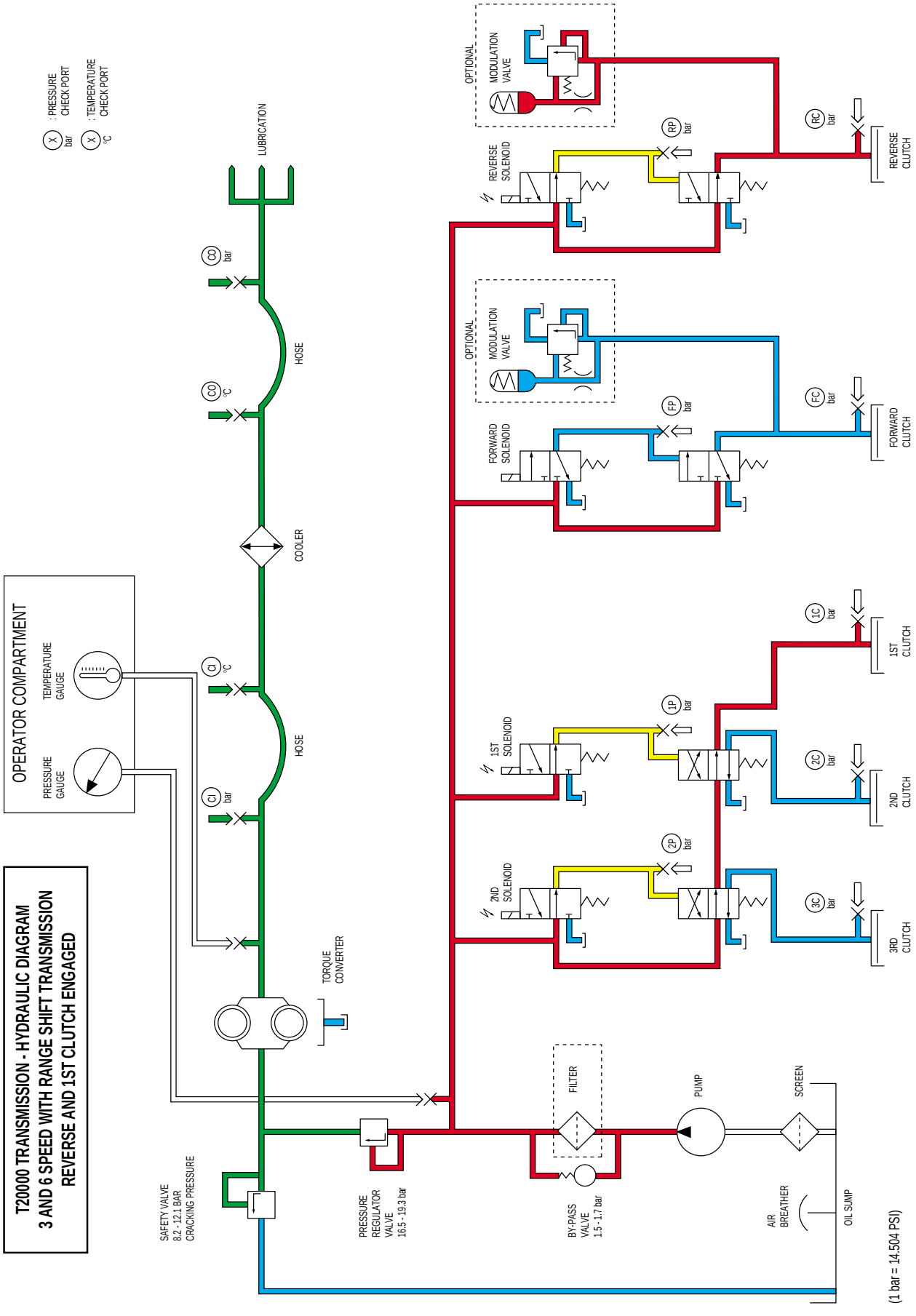
6.3.4 Forward 3rd speed and high range selected (continued)



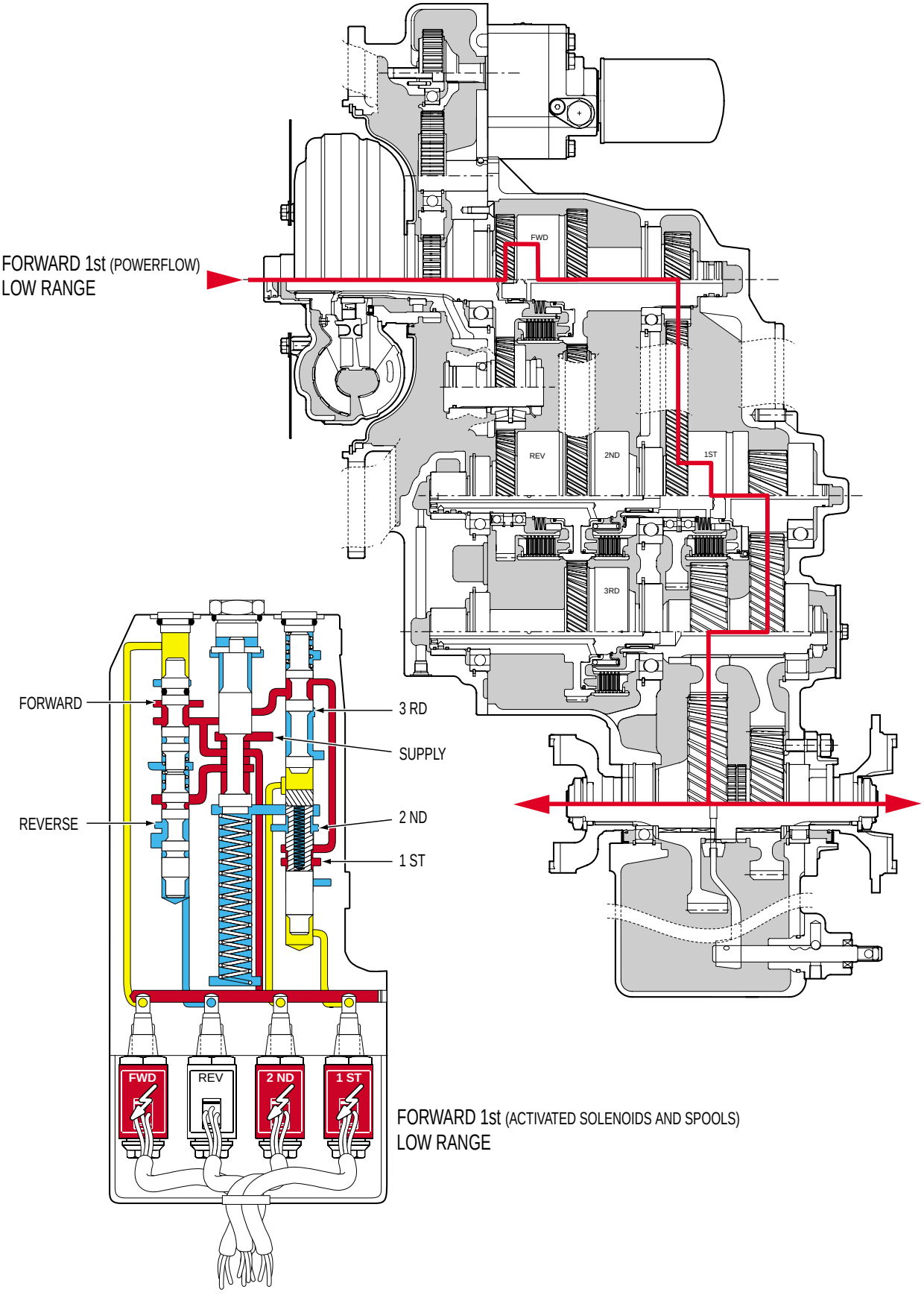
6.3.5 Reverse 1st speed and high range selected



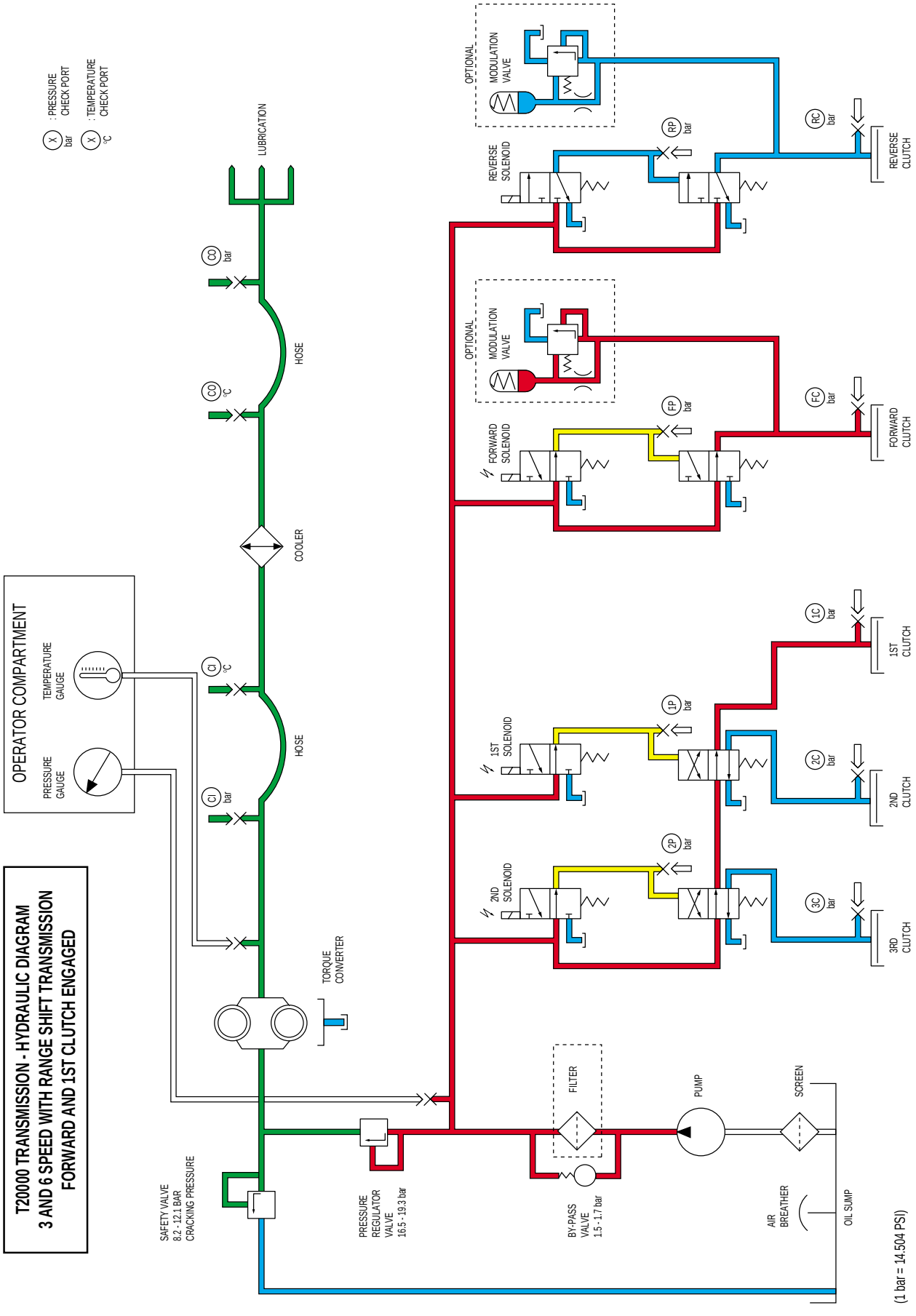
6.3.5 Reverse 1st speed and high range selected (continued)



6.3.6 Forward 1st speed and low range selected

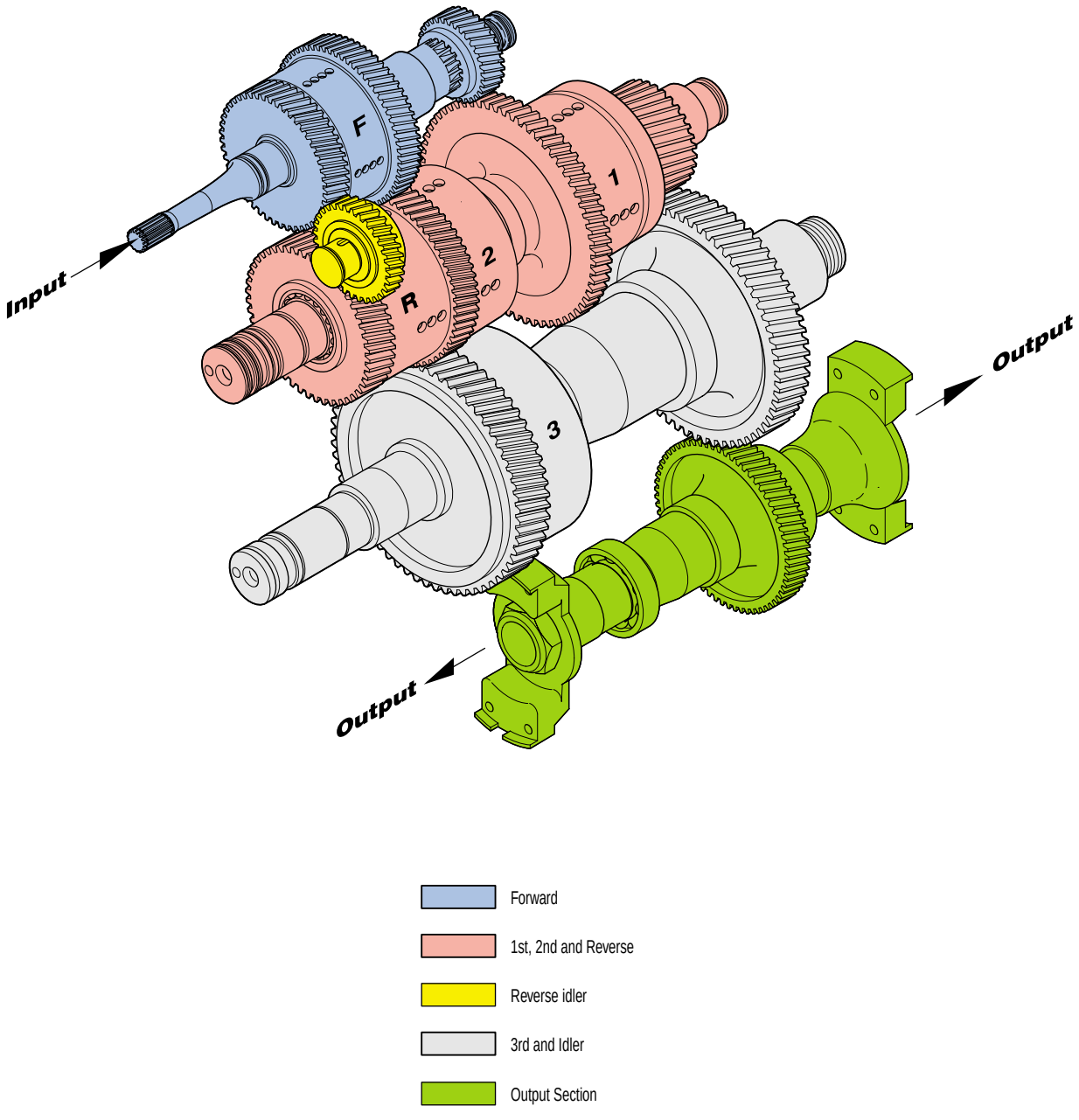


6.3.6 Forward 1st speed and low range selected (continued)

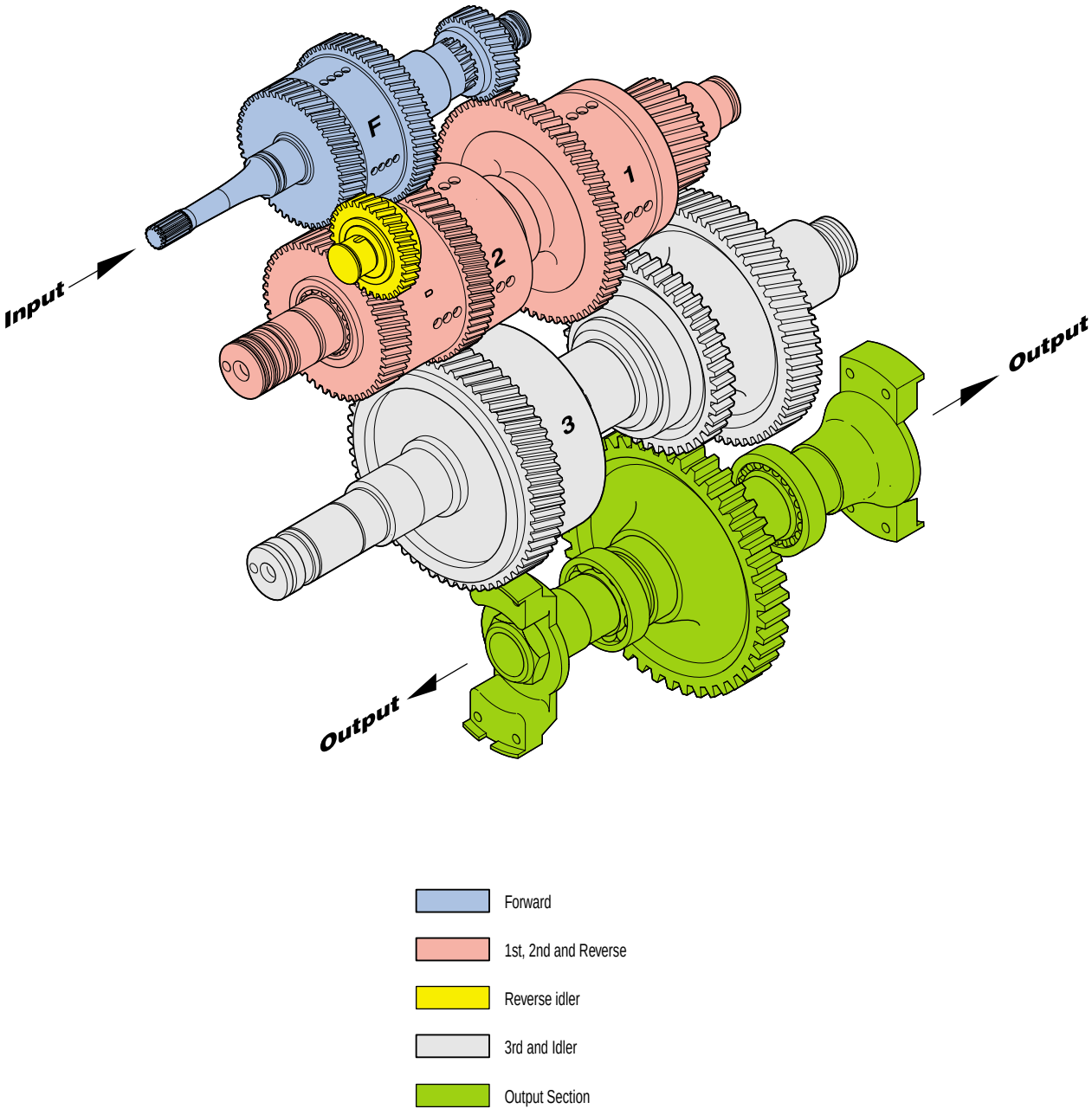


6.4 GEAR AND CLUTCH LAY-OUT

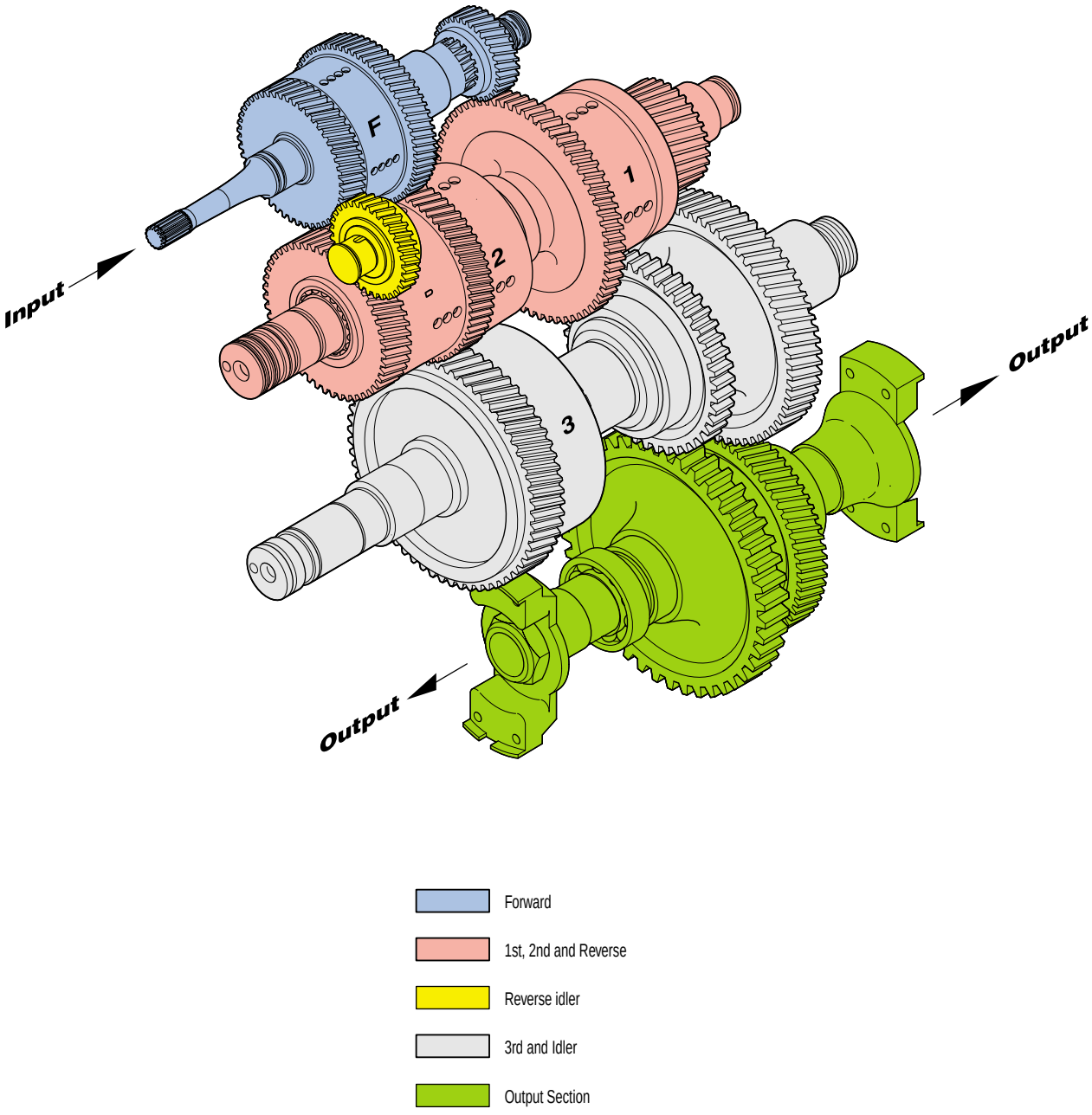
6.4.1 3-Speed with standard ratio



6.4.2 3-Speed with deep ratio



6.4.2 6-Speed with range shift



7. TROUBLESHOOTING GUIDE FOR THE T20000 TRANSMISSION

The following information is presented as an aid to isolating and determining the specific problem area in a transmission that is not functioning correctly.

When troubleshooting a “transmission” problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connecting lines, and controls, including the engine, as a complete system.

By analysing the principles of operation together with the information in this section, it should be possible to identify and correct any malfunction which may occur in the system.

7.1 T20000 TRANSMISSION

T20000 (power shift with torque converter transmission) troubles fall into three general categories:

1. Mechanical problems.
2. Hydraulic problems.
3. Electrical problems.

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the “life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping, and to cool and lubricate the working components.

7.2 TROUBLESHOOTING PROCEDURES

7.2.1 Stall Test

A stall test to identifies transmission, converter, or engine problems.

Use following procedure:

1. Put the vehicle against a solid barrier, such as a wall, and/or apply the parking brake and block the wheels.
2. Put the directional control lever in FORWARD (or REVERSE, as applicable).
3. Select the highest speed.
   With the engine running, slowly increase engine speed to approximately one-half throttle and hold until transmission (converter outlet) oil temperature reaches the operating range.

CAUTION

DO NOT OPERATE THE CONVERTER AT STALL CONDITION LONGER THAN 30 SECONDS AT ONE TIME, SHIFT TO NEUTRAL FOR 15 SECONDS AND REPEAT THE PROCEDURE UNTIL DESIRED TEMPERATURE IS REACHED.
EXCESSIVE TEMPERATURE 120 °C (250 F) MAXIMUM WILL CAUSE DAMAGE TO TRANSMISSION CLUTCHES, FLUID, CONVERTER, AND SEALS.

7.2.2 Transmission pressure checks

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.

In addition, converter charging pressure and transmission lubrication pressure can also be measured.

7.2.3 Mechanical and electrical checks

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake and inching pedal for correct adjustment.
- Be sure all lever linkage is properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Be sure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

7.2.4 Hydraulic checks

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:

Check oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times.

Note

THE TRANSMISSION FLUID MUST BE AT OPERATING TEMPERATURE OF 82 - 93 °C (180 - 200 F) TO OBTAIN CORRECT FLUID LEVEL AND PRESSURE READINGS.
DO NOT ATTEMPT TO MAKE THESE CHECKS WITH COLD OIL.

To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with converter at “stall” (Refer to 7.2.1 “Stall test”).

CAUTION

BE CAREFUL THAT THE VEHICLE DOES NOT MOVE UNEXPECTEDLY WHEN OPERATING THE ENGINE AND CONVERTER AT STALL RPM.

7.3 TROUBLESHOOTING GUIDE

Refer to the following troubleshooting guide for the diagnosis of typical transmission troubles.

7.3.1 Low clutch pressure

CAUSE	REMEDY
1. Low oil level.	1. Fill to proper level.
2. Clutch pressure regulating valve stuck open.	2. Clean valve spool and housing.
3. Faulty charging pump.	3. Replace pump.
4. Broken or worn clutch shaft or piston sealing rings.	4. Replace sealing rings.
5. Clutch piston bleed valve stuck open.	5. Clean bleed valves thoroughly.

7.3.2 Low charging pump output

CAUSE	REMEDY
1. Low oil level.	1. Fill to proper level.
2. Suction screen plugged.	2. Clean suction pump.
3. Defective charging pump.	3. Replace pump.

7.3.3 Overheating

Cause	Remedy
1. Worn oil sealing rings.	1. Remove, disassemble, and rebuild converter assembly.
2. Worn charging pump.	2. Replace charging pump.
3. Low oil level.	3. Fill to proper level.
4. Dirty oil cooler.	4. Clean cooler.
5. Restriction in cooler lines.	5. Change cooler lines.

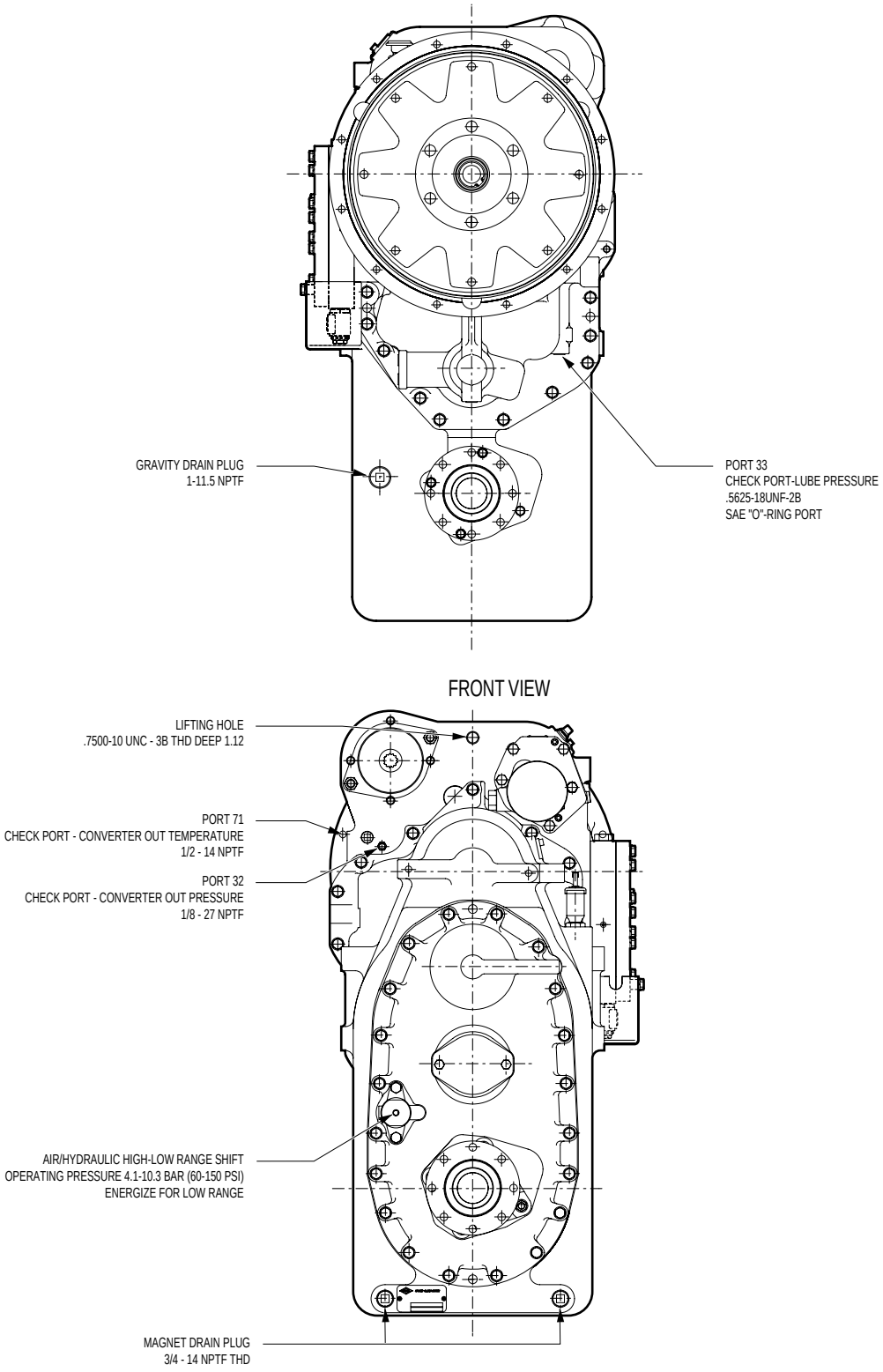
7.3.4 Noisy converter

Cause	Remedy
1. Worn charging pump.	1. Replace charging pump.
2. Worn or damaged bearings.	2. A complete disassembly will be necessary to determine which bearing is faulty.

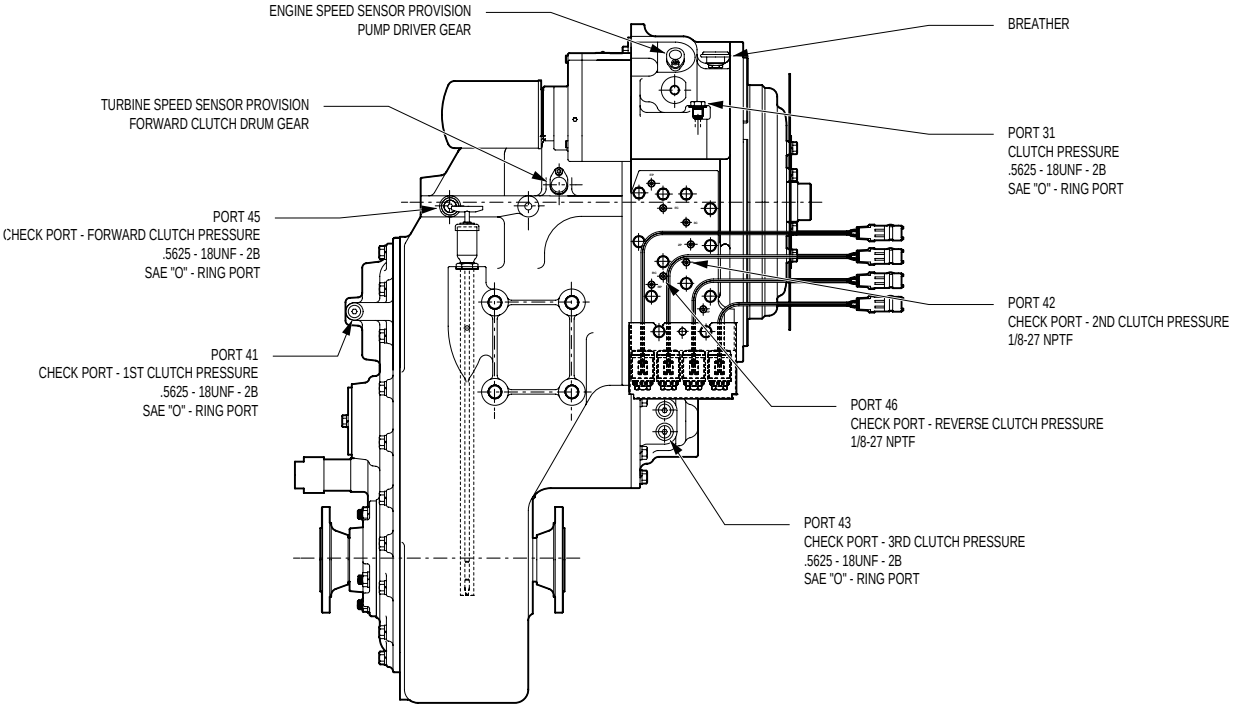
7.3.5 Lack of power

Cause	Remedy
1. Low engine RPM at converter stall.	1. Tune engine check governor.
2. See “Overheating” and make same checks.	2. Make corrections as explained in “Overheating”.

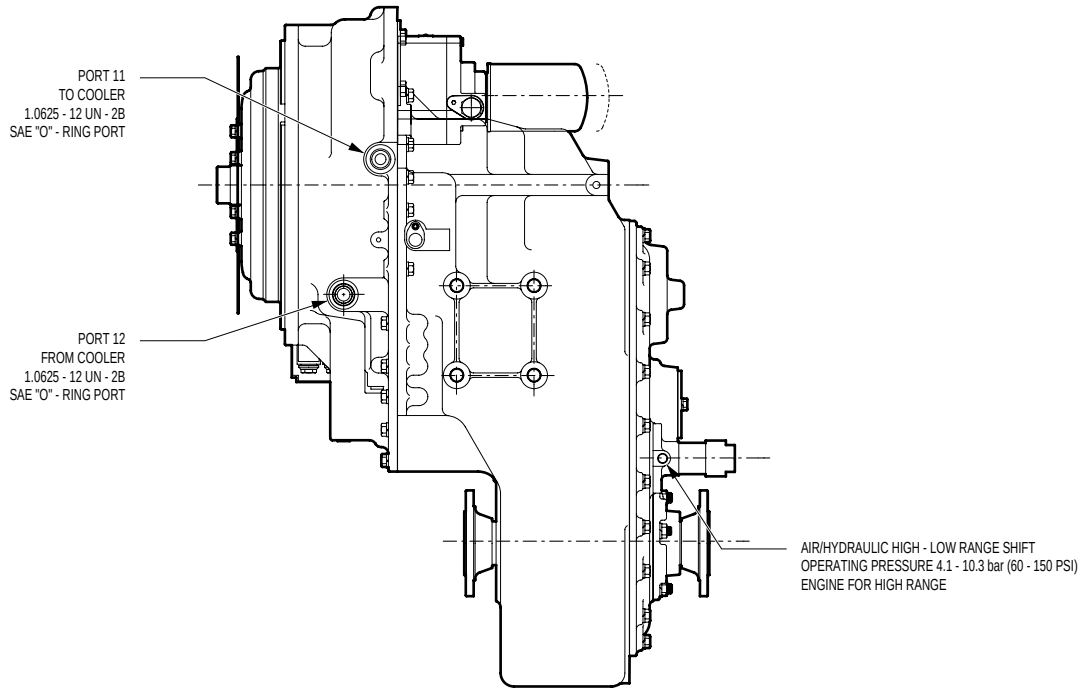
7.4 CHECK POINTS



7.4 CHECK POINTS (CONTINUED)

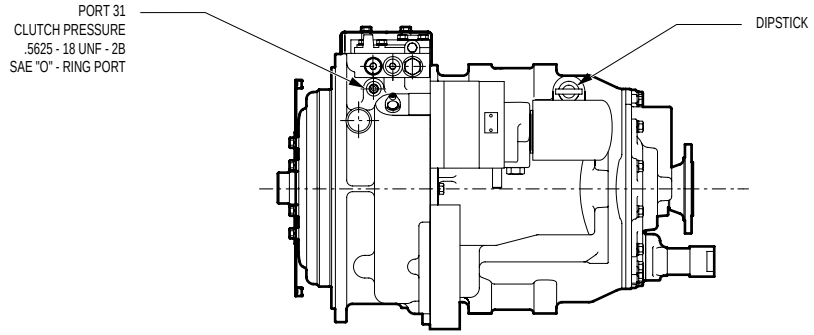


RIGHT SIDE VIEW


PORT 11
TO COOLER
1.0625 - 12 UN - 2B
SAE "O" - RING PORT
PORT 12
FROM COOLER
1.0625 - 12 UN - 2B
SAE "O" - RING PORT
AIR/HYDRAULIC HIGH - LOW RANGE SHIFT
OPERATING PRESSURE 4.1 - 10.3 bar (60 - 150 PSI)
ENGINE FOR HIGH RANGE

LEFT SIDE VIEW

7.4 CHECK POINTS (CONTINUED)



TOP VIEW

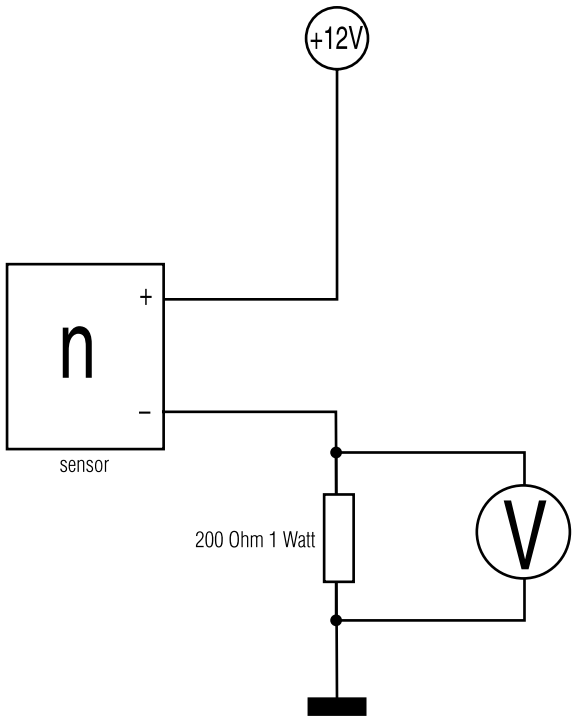
7.5 SPEED SENSOR - STATIC STANDALONE TEST

In order to be able to sense the currents, a series resistor of e.g. 200 Ohms must be used. This resistor is integrated in the controller, but when the sensor is to be tested, it must be connected externally.

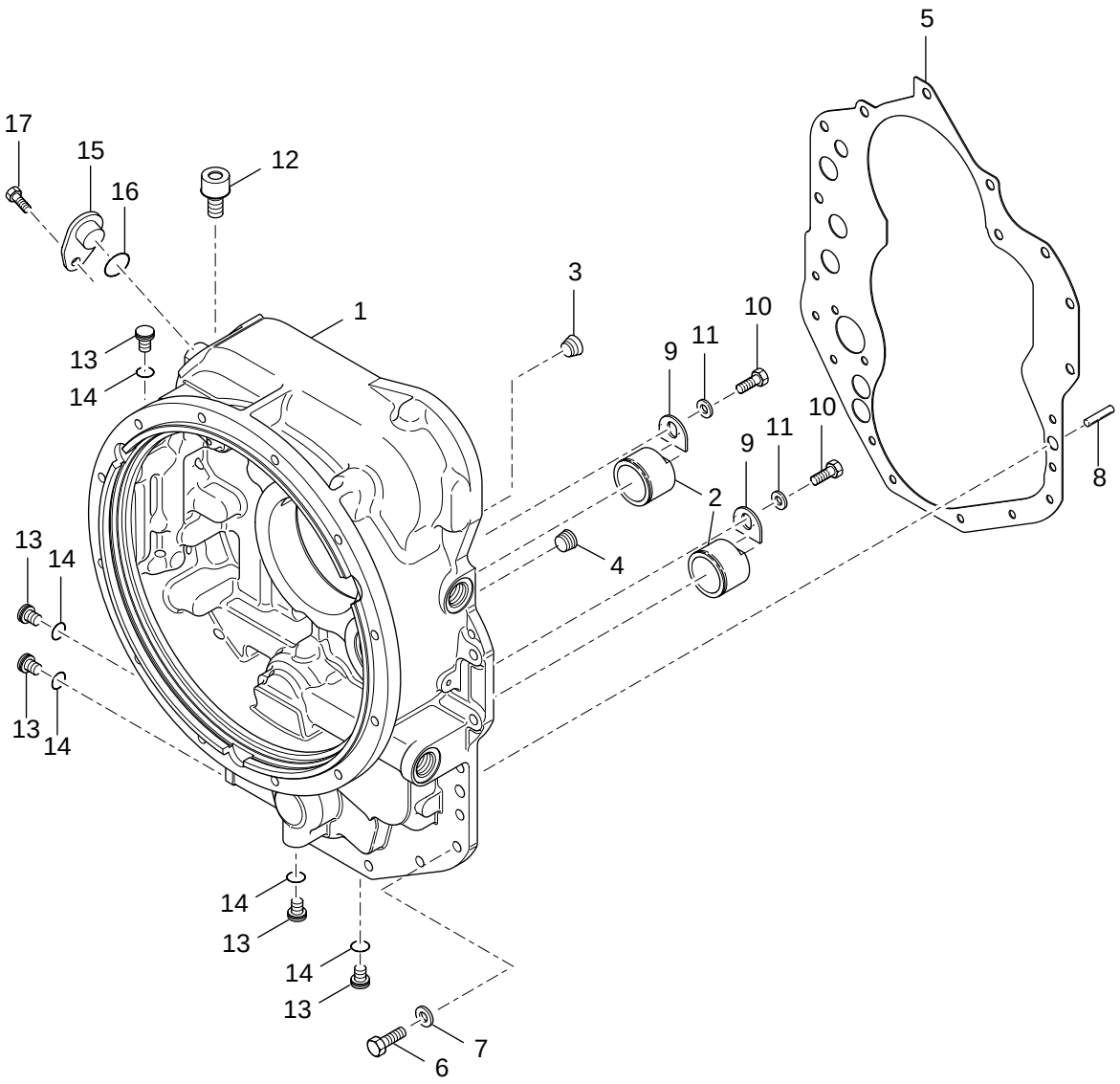
The idea is to connect the sensor to an external power source and measure the DC voltage across the series resistor.

The voltage reading should be either 1.2V-1.6V (for the 7mA ± 1mA current level) or 2.6-3.0V (for the 14mA ± 1mA current level)

If the teeth can be moved slowly, distinct toggling between the two levels should be noticed.



8. SECTIONAL VIEWS AND PARTS IDENTIFICATION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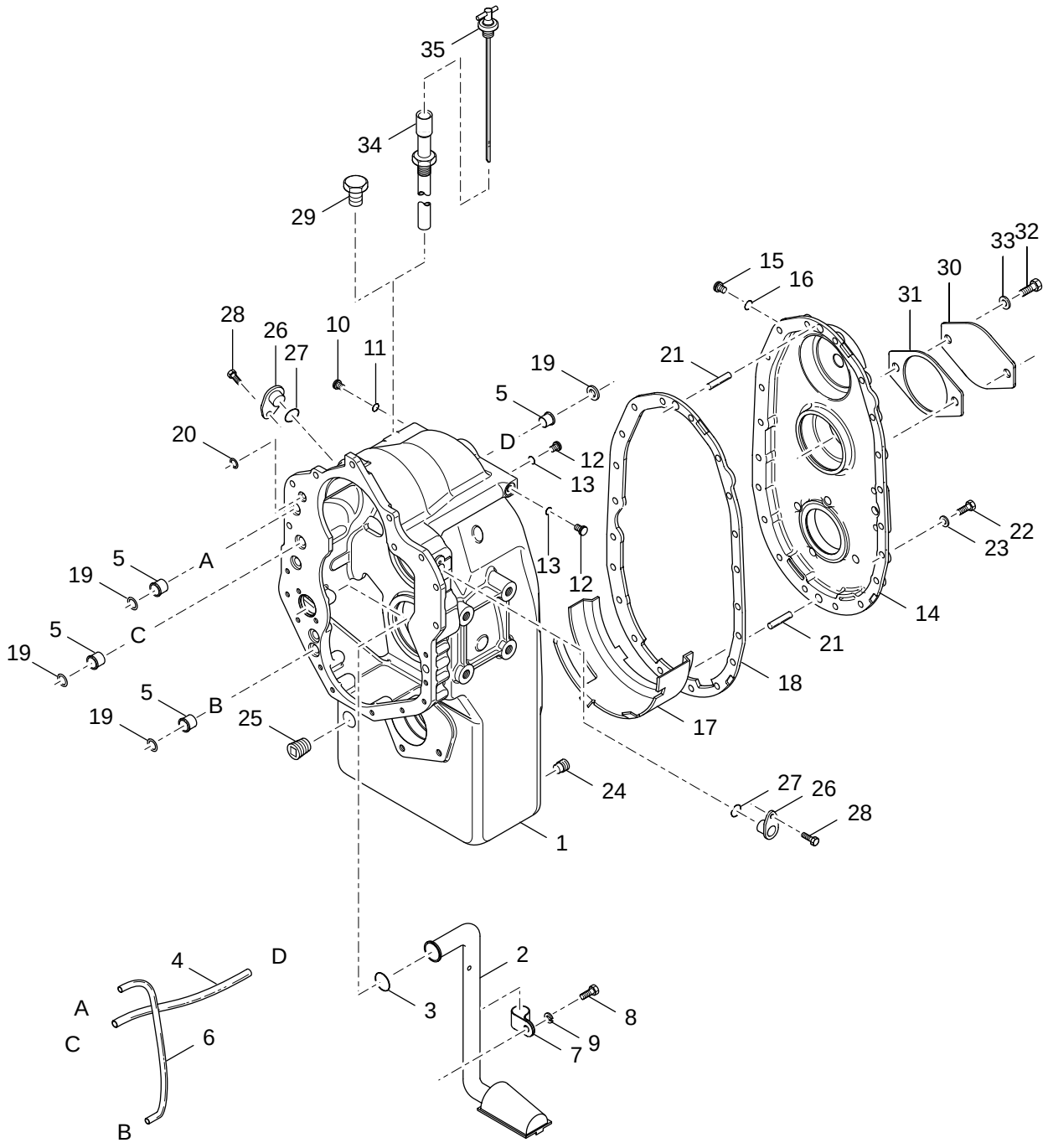
GROUP - CONVERTER HOUSING

Item	Description	Quantity
1	Housing - Converter	1
2	Sleeve - Converter housing	2
3	Plug - pipe	1
4	Plug - pipe	1
5	Gasket - Converter housing to to transmission case	1
6	Screw - Converter housing to transmission case	18
7	Lockwasher - Converter housing to transmission case screw	18
8	Pin - Converter housing to transmission case dowel	1
9	Clip	2
10	Screw - Clip	2
11	Lockwasher - Clip screw	2
12	Air - Breather	1
13	Plug	5
14	“O”-ring	5
15	Plug - Speed sensor port	1
16	“O”-ring - Speed sensor	1
17	Screw - Speed sensor	1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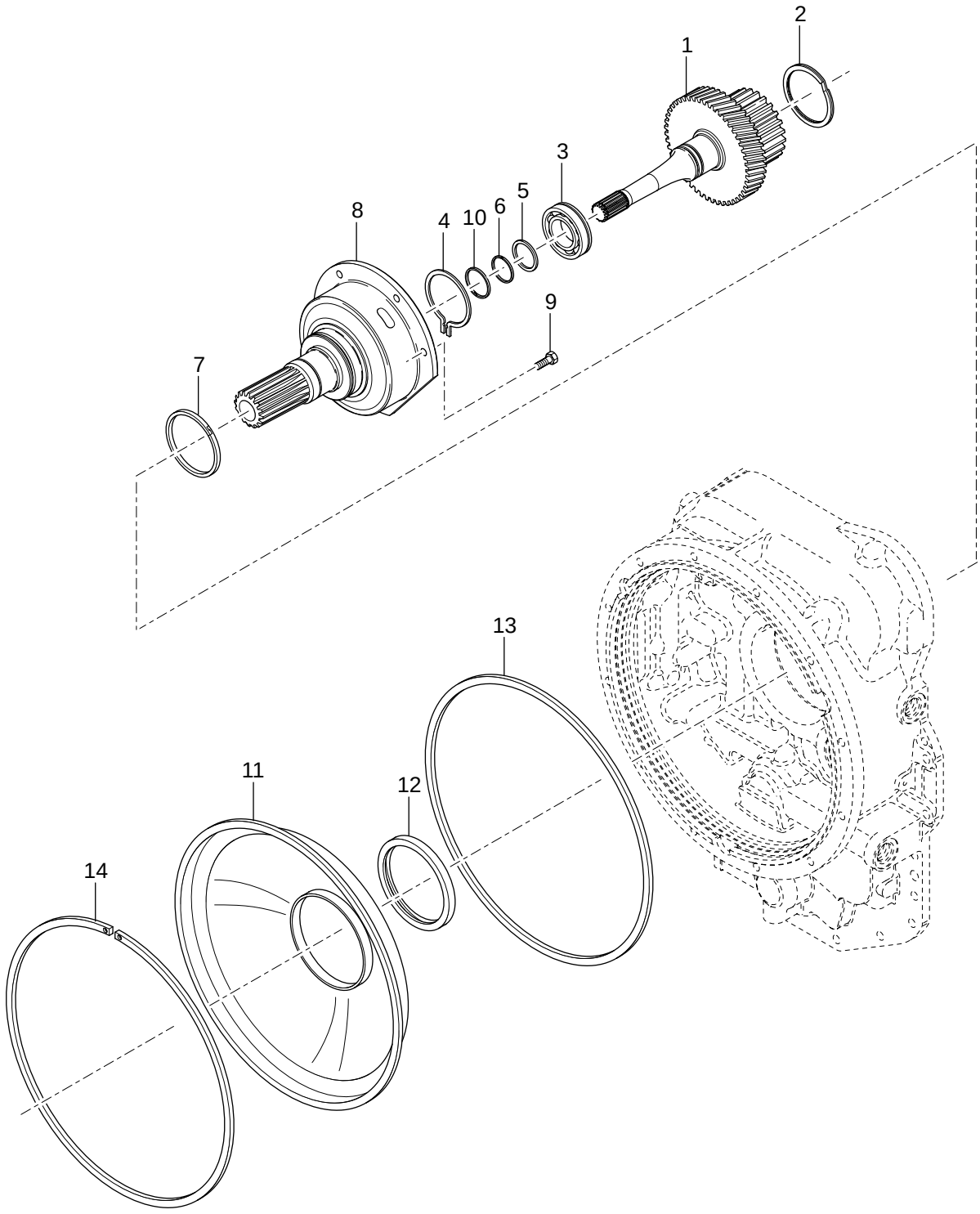
GROUP -TRANSMISSION CASE AND REAR COVER

Item	Description	Quantity
1	Assembly - Transmission case	1
2	Assembly - Suction tube	1
3	“O”-ring - Suction tube assembly	1
4	Tube - Low speed pressure	1
5	Sleeve - Clutch pressure tube	4
6	Tube - 3rd clutch pressure	1
7	Clip	1
8	Screw - Tube clip	1
9	Lockwasher - Tube clip screw	1
10	Plug	1
11	“O”-ring	1
12	Plug	2
13	“O”-ring	1
14	Cover - Rear	1
15	Plug	1
16	“O”-ring	1
17	Oil - Baffle	1
18	Gasket - Transmission case to rear cover	1
19	“O”-ring - Clutch pressure tube	4
20	“O”-ring - Clutch pressure	1
21	Pin - Transmission case to rear cover dowel	2
22	Screw - Rear cover to transmission case	20
23	Lockwasher - Rear cover to transmission case	20
24	Plug - Magnetic drain	2
25	Plug - Drain back hole	1
26	Plug - Speed sensor port	2
27	“O”-ring - Speed sensor	2
28	Screw - Speed sensor	2
29	Plug - Dipstick hole	1
30	Cover	1
31	Gasket - Cover	1
32	Screw - Cover	2
33	Lockwasher - Cover screw	2
34	Assembly - Dipstick hole	1
35	Dipstick	1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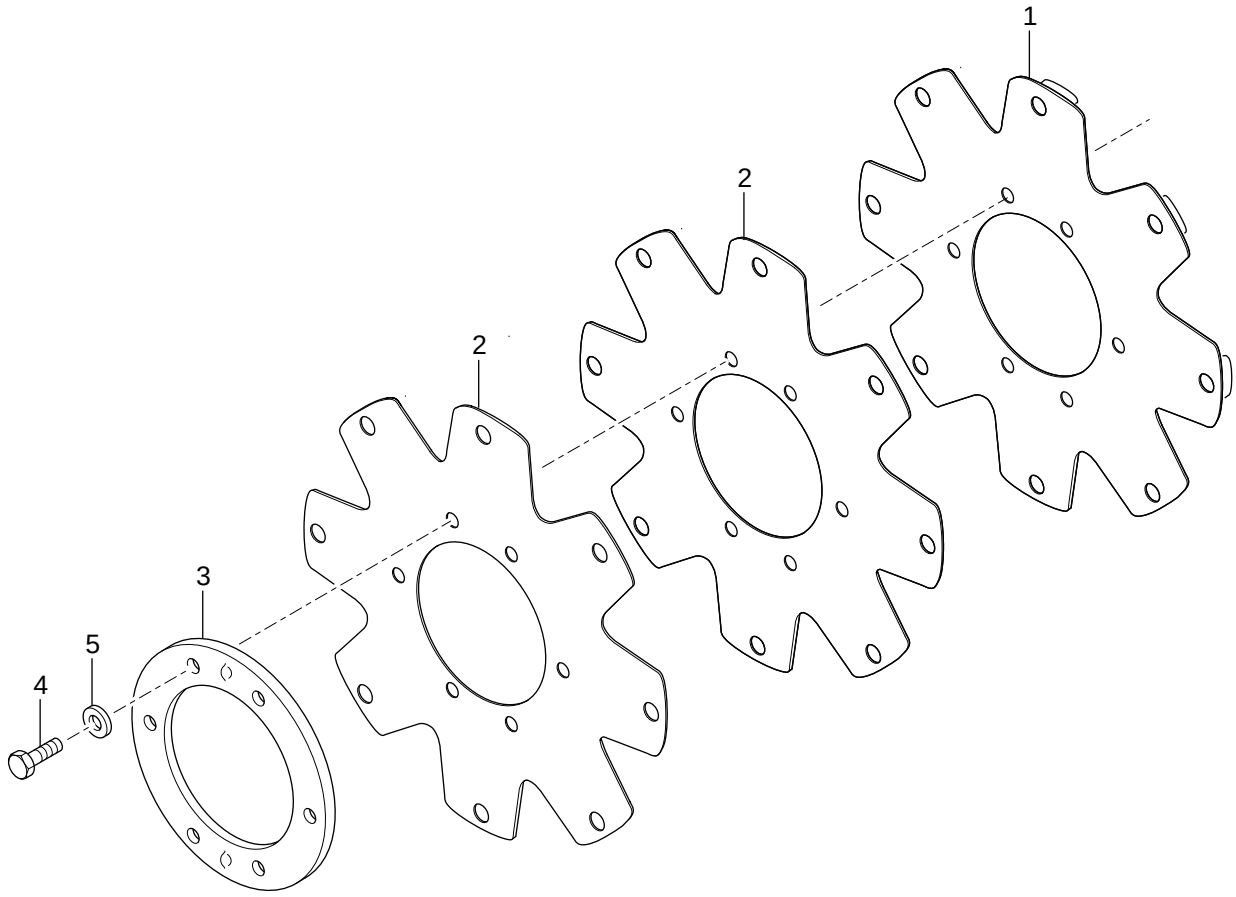
GROUP - TURBINE SHAFT

Item	Description	Quantity
1	Assembly - Turbine shaft & hub	1
2	Ring -Retainer	1
3	Bearing - Ball	1
4	Snap ring - Bearing	1
5	Washer - Bearing support	1
6	Ring - Bearing retaining	1
7	Ring - Piston	1
8	Support - Stator	1
9	Screw - Stator support	6
10	Ring - Piston	1
11	Baffle - Oil	1
12	Seal - Oil baffle	1
13	Ring - Oil baffle seal	1
14	Ring - Oil baffle retaining	1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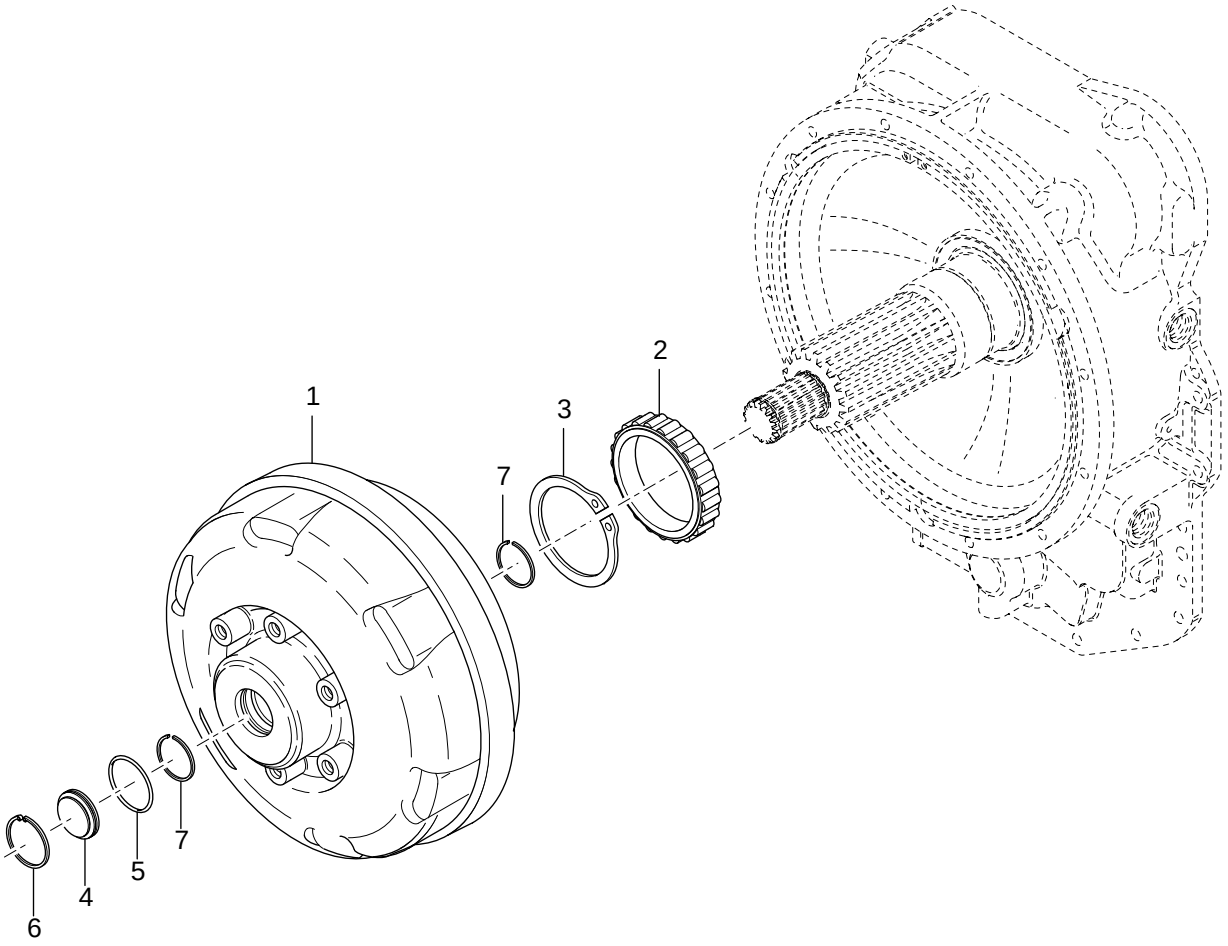
GROUP - DRIVE PLATE

Item	Description	Quantity
1	Assembly - Drive plate	1
2	Drive - Plate	2
3	Ring - Drive plate backing	1
4	Screw - Drive plate mounting	6
5	Lockwasher - Drive plate mounting	6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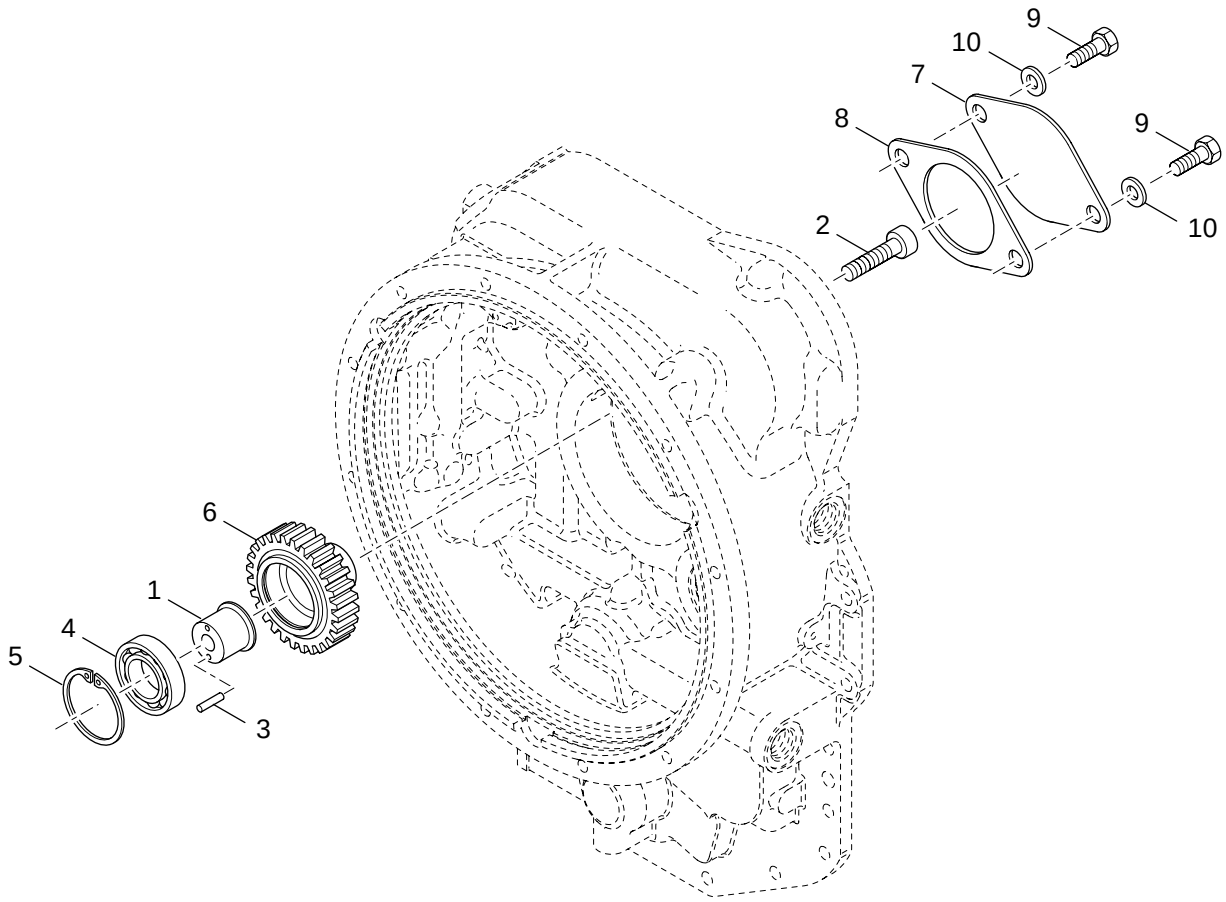
GROUP - TORQUE CONVERTER

Item	Description	Quantity
1	Assembly - Torque converter	1
2	Bearing - Impeller hub gear	1
3	Ring - External snap	1
4	Plug - Torque converter	1
5	“O”-ring - Torque converter plug	1
6	Ring - Snap	1
7	Ring - Turbine retaining	2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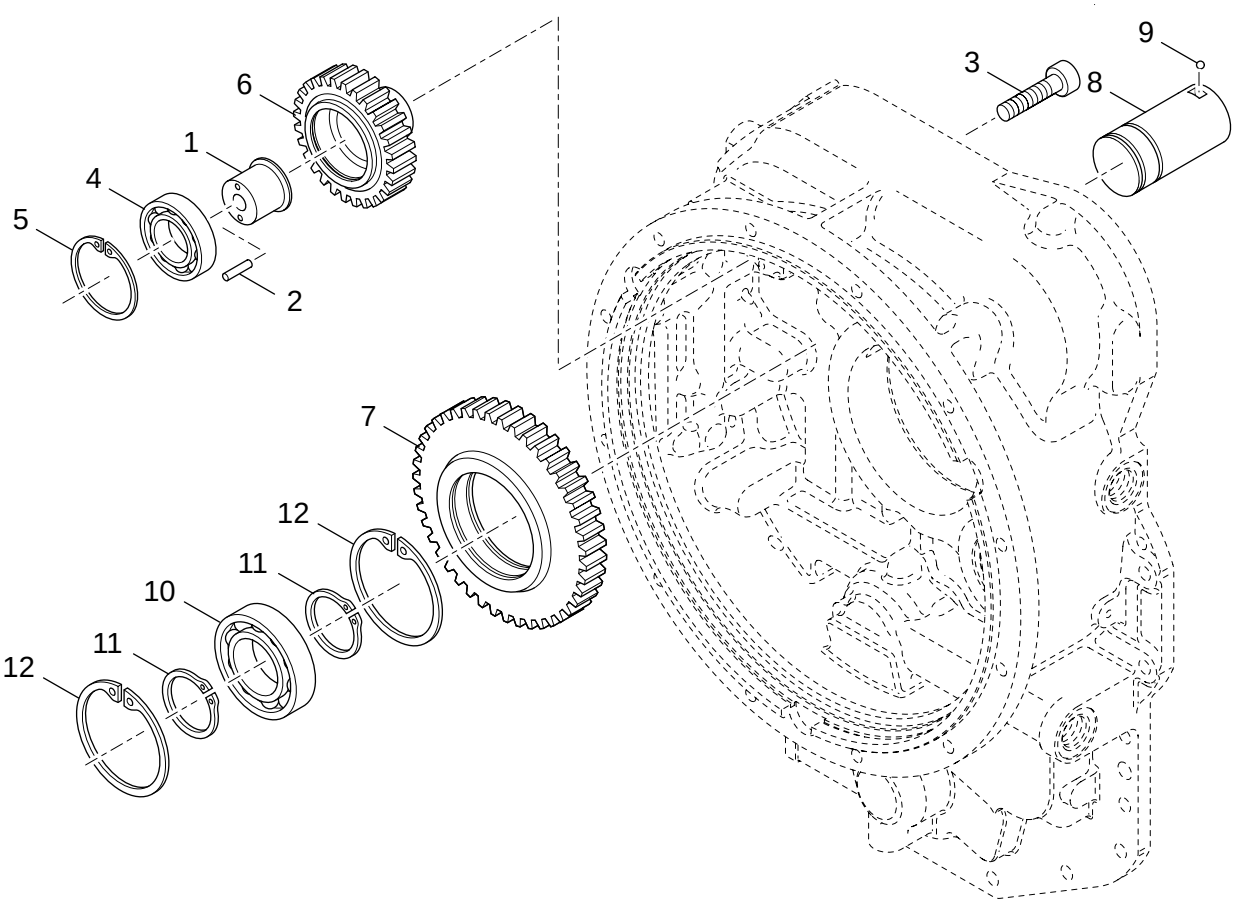
GROUP - AUXILIARY PUMP DRIVE

Item	Description	Quantity
1	Support - Pump drive bearing	1
2	Screw - Bearing support	1
3	Pin - Bearing support	1
4	Bearing - Ball	1
5	Ring - Drive gear bearing retaining	1
6	Gear - Auxiliary pump drive	1
7	Cover - Pump mounting permanent	1
8	Gasket - Shipping cover	1
9	Screw - Pump mounting permanent cover	2
10	Lockwasher - Pump cover screw	2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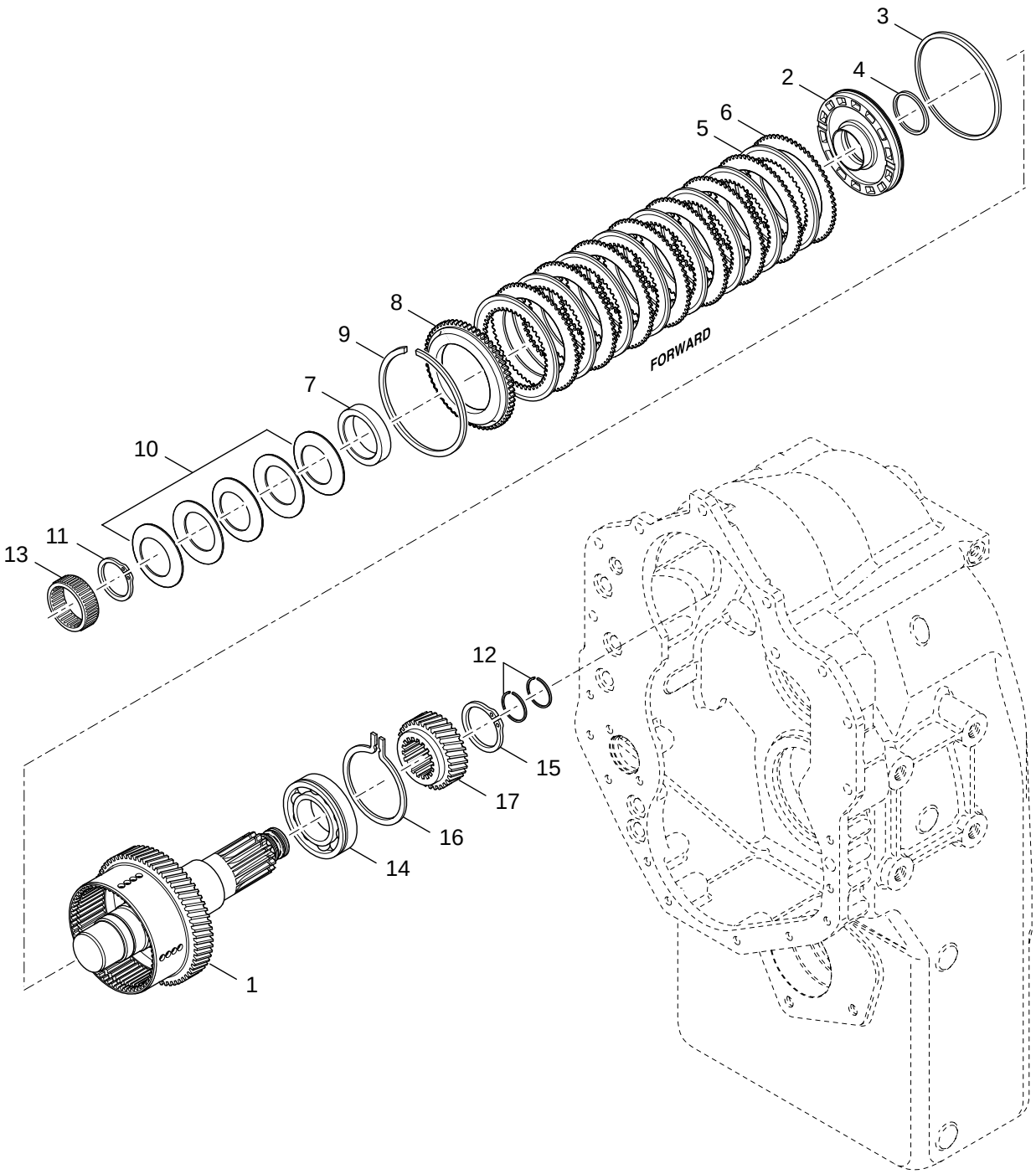
GROUP - PUMP DRIVE

Item	Description	Quantity
1	Support - Pump drive bearing	1
2	Pin - Bearing support	1
3	Screw - Bearing support	1
4	Bearing - Ball	1
5	Ring - Drive gear bearing retaining	1
6	Gear - Charging pump drive	1
7	Gear - Pump drive idler	1
8	Shaft - Idler gear stub	1
9	Ball - Idler shaft lock	1
10	Bearing - Ball	1
11	Ring - Idler gear bearing location	2
12	Ring - Idler gear bearing retaining	2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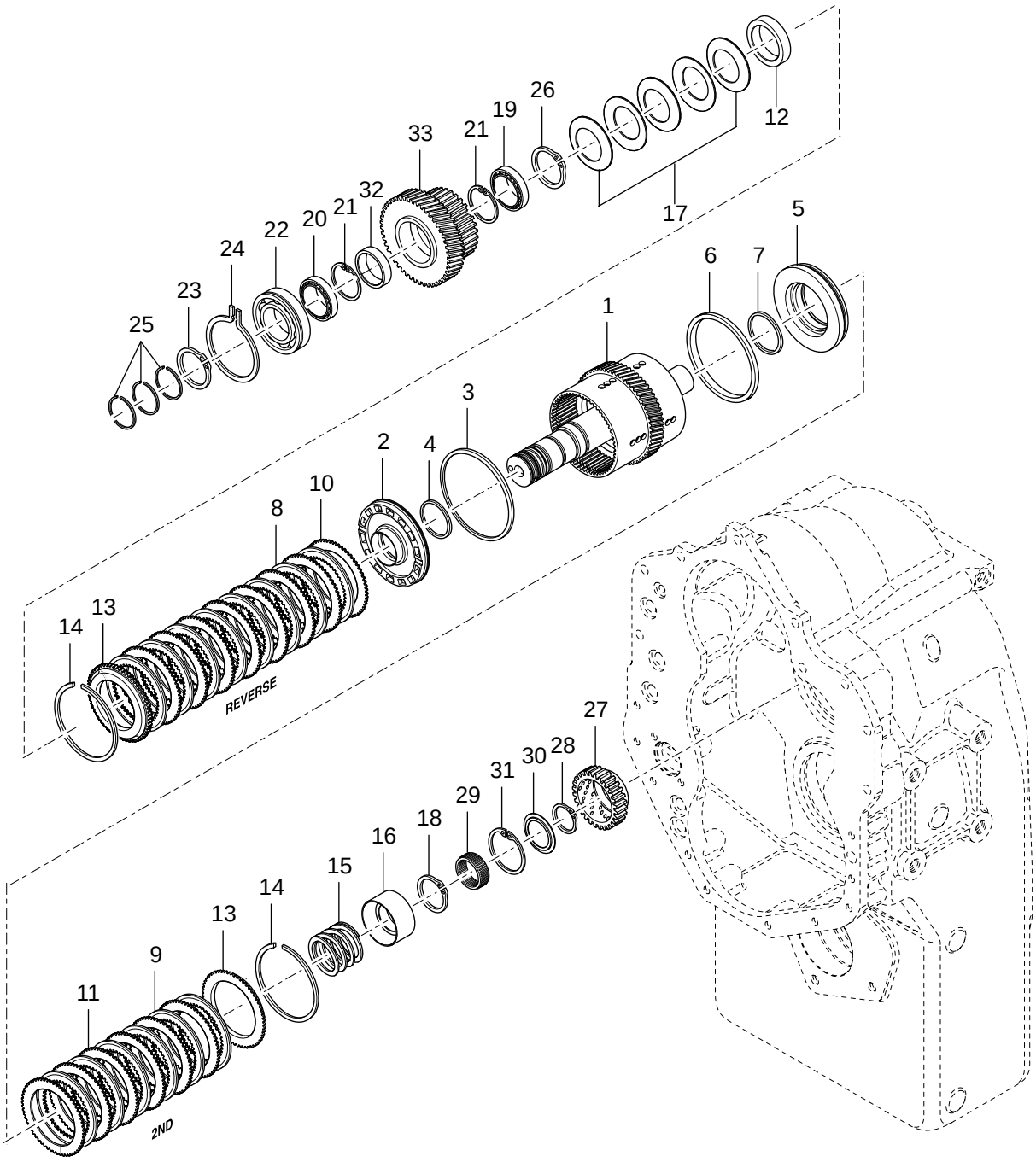
GROUP - FORWARD SHAFT

Item	Description	Quantity
1	Assembly - Forward shaft and drum	1
2	Piston - Clutch	1
3	Seal - Clutch piston (Outer)	1
4	Seal - Clutch piston (Inner)	1
5	Disc - Clutch (Inner)	8
6	Disc - Clutch (Outer)	8
7	Spacer - Piston return spring	1
8	Plate - Clutch disk backing	1
9	Snap ring - Backing plate	1
10	Assembly - Disc spring	1
11	Snap ring - Spring retaining	1
12	Ring - Forward shaft piston	2
13	Bearing - Forward shaft pilot	1
14	Bearing - Ball	1
15	Ring - Gear retaining	1
16	Ring - Bearing retaining	1
17	Gear - First drive	1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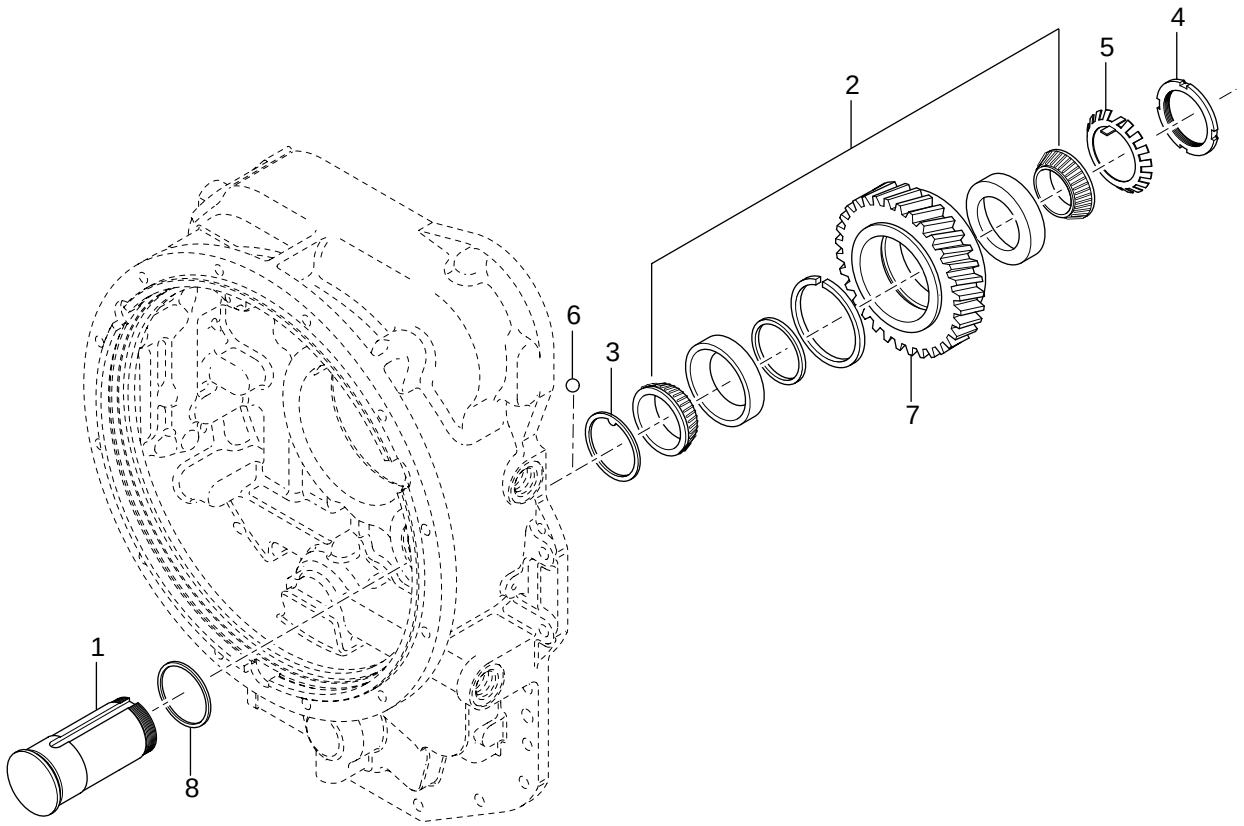
GROUP - REVERSE AND 2ND SHAFT

Item	Description	Quantity
1	Assembly - Reverse, 2nd shaft & drum	1
2	Piston - Clutch	1
3	Seal - Clutch piston (Outer)	1
4	Seal - Clutch piston (Inner)	1
5	Piston - Clutch	1
6	Seal - Clutch piston (Outer)	1
7	Seal - Clutch piston (Inner)	1
8	Disc - Clutch (Inner)	8
9	Disc - Clutch (Inner)	6
10	Disc - Clutch (Outer)	8
11	Disc - Clutch (Outer)	6
12	Spacer - Piston return spring	1
13	Plate - Clutch disc backing	2
14	Snap ring - Backing plate	2
15	Spring - Piston return	1
16	Retaining - Spring	1
17	Assembly - Disk spring	1
18	Snap ring - Spring retaining	1
19	Bearing - Clutch driven gear	1
20	Bearing - Clutch driven gear	1
21	Ring - Reverse clutch gear bearing	2
22	Bearing - Ball	1
23	Ring - Front bearing retaining	1
24	Snap ring - Front bearing	1
25	Ring - Piston	3
26	Snap ring - Spring retaining	1
27	Hub - 2nd clutch	1
28	Ring - 2nd clutch disc hub retaining	1
29	Bearing - Needle	1
30	Retainer - Retaining ring	1
31	Ring - Retainer location	1
32	Spacer - Reverse clutch gear	1
33	Gear - Reverse clutch	1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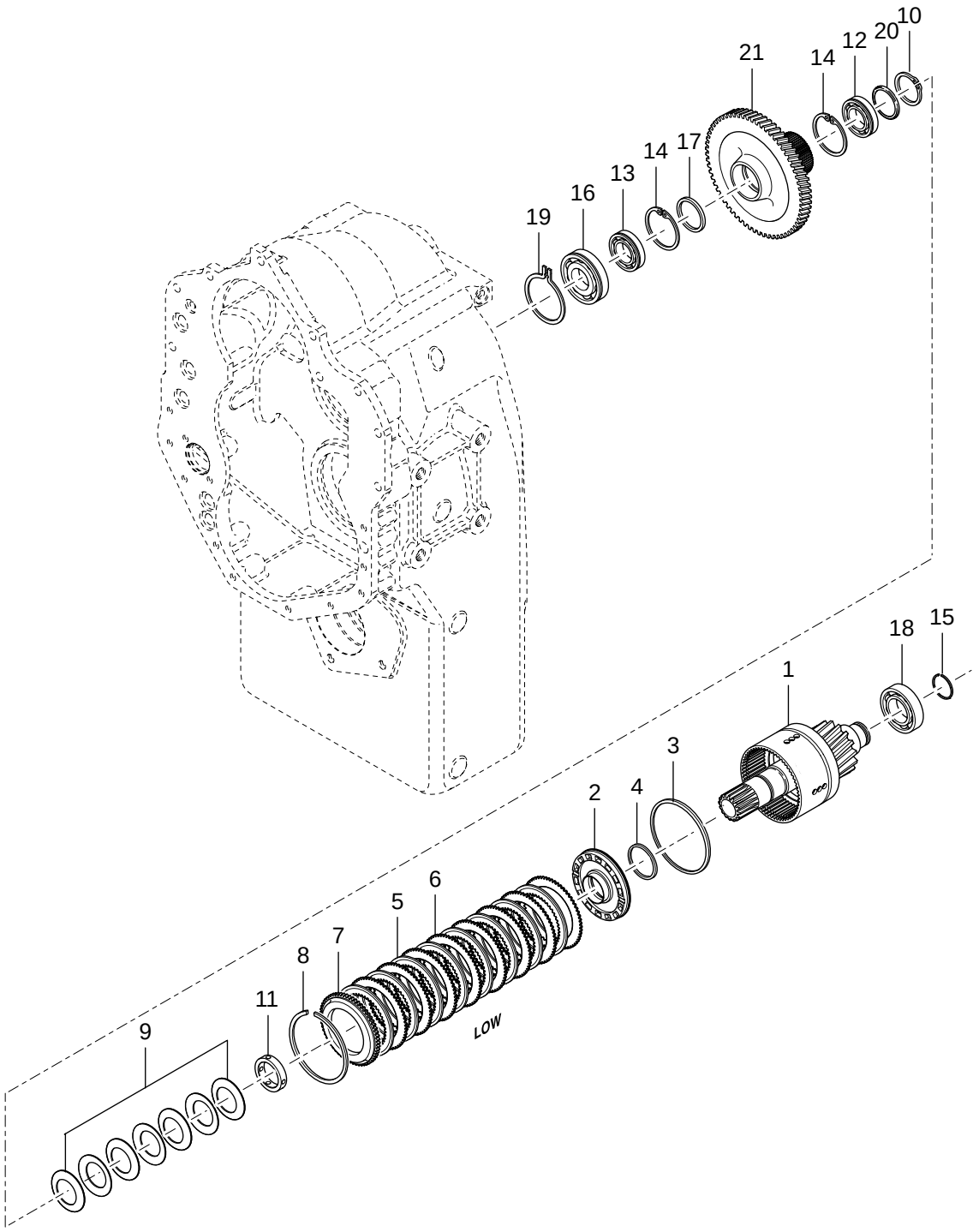
GROUP - REVERSE IDLER

Item	Description	Quantity
1	Shaft - Reverse idler	1
2	Assembly - Reverse idler bearing	1
3	Washer	1
4	Nut - Bearing retaining	1
5	Washer - Bearing retaining	1
6	Lockball - Idler shaft	1
7	Gear - Reverse idler	1
8	“O”-ring - Idler shaft	1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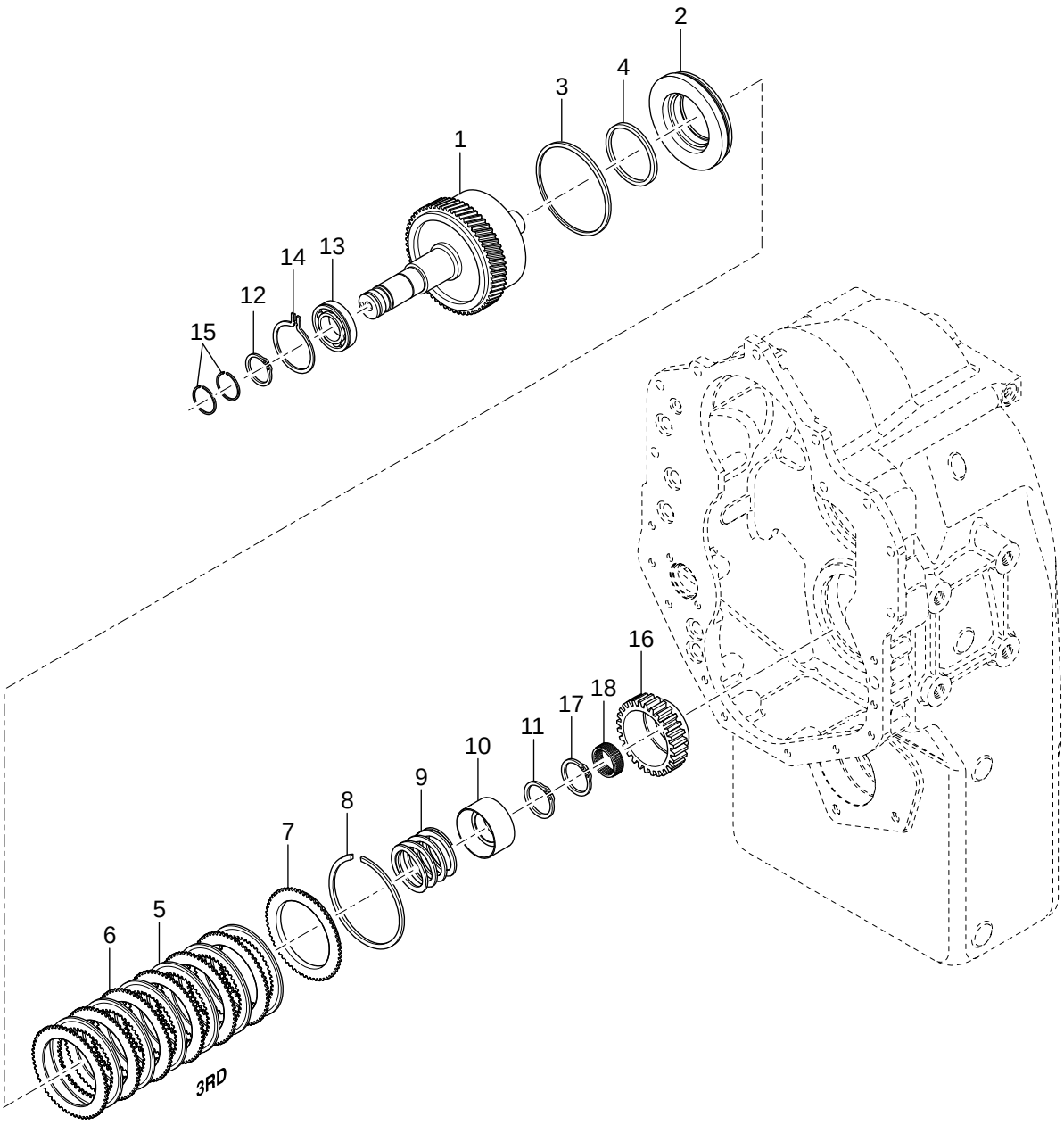
LOW

GROUP - LOW SPEED SHAFT

Item	Description	Quantity
1	Assembly - Low shaft, hub and drum	1
2	Piston - Clutch	1
3	Seal - Clutch piston (Outer)	1
4	Seal - Clutch piston (Inner)	1
5	Disc - Clutch (Inner)	8
6	Disc - Clutch (Outer)	8
7	Plate - Clutch disc backing	1
8	Ring - Backing plate retaining	1
9	Assembly - Disc spring	1
10	Snap ring - Spring retainer	1
11	Spacer - Belleville washer	1
12	Bearing - Low speed gear	1
13	Bearing - Low speed gear	1
14	Ring - Low speed gear location	2
15	Ring - Low shaft piston	1
16	Bearing - Ball	1
17	Spacer - Low speed gear bearing	1
18	Bearing - Ball	1
19	Snap ring	1
20	Retainer - Belleville washer	1
21	Gear - Low clutch	1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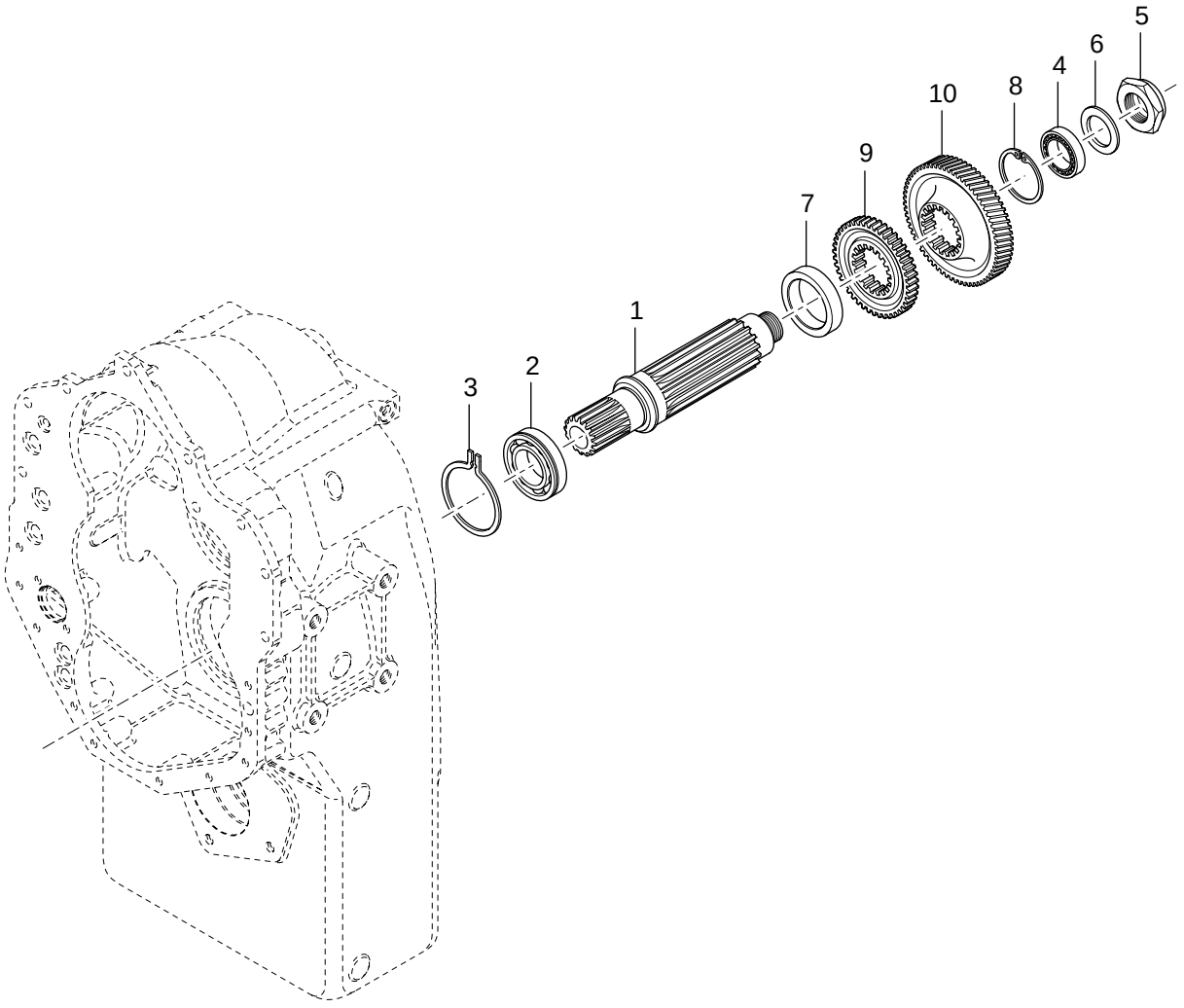
3RD

GROUP - 3RD SHAFT

Item	Description	Quantity
1	Assembly - 3rd shaft & drum	1
2	Assembly - Clutch piston	1
3	Seal - Clutch piston (Outer)	1
4	Seal - Clutch piston (Inner)	1
5	Disc - Clutch (Inner)	6
6	Disc - Clutch (Outer)	6
7	Plate - Clutch disc backing	1
8	Snap ring - Backing plate	1
9	Spring - Piston return	1
10	Retainer - Spring	1
11	Snap ring - Spring retaining	1
12	Ring - Front bearing retaining	1
13	Bearing - Ball	1
14	Snap ring - Front bearing	1
15	Ring - Piston	2
16	Hub - 3rd clutch	1
17	Ring - 3rd clutch disc hub retaining	1
18	Bearing - Needle	1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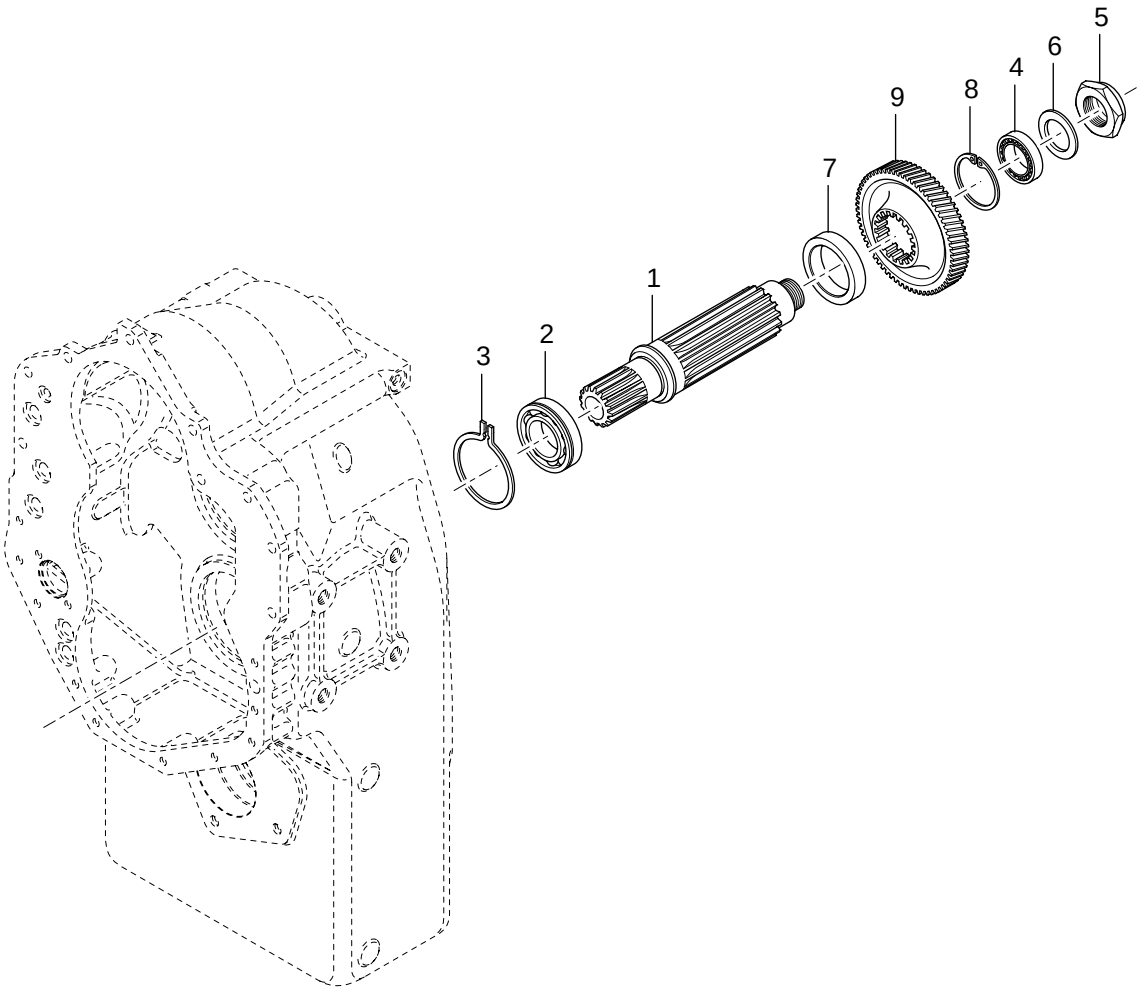
GROUP - IDLER SHAFT (USED IN 6 SPEED AND 3 SPEED WITH DEEP RATIO)

Item	Description	Quantity
1	Shaft - Idler	1
2	Bearing - Ball	1
3	Snap ring - Bearing	1
4	Bearing - Roller	1
5	Nut - Bearing	1
6	Washer - Bearing nut	1
7	Spacer - Idler shaft gear	1
8	Snap ring	1
9	Gear - Idler	1
10	Gear - Idler	1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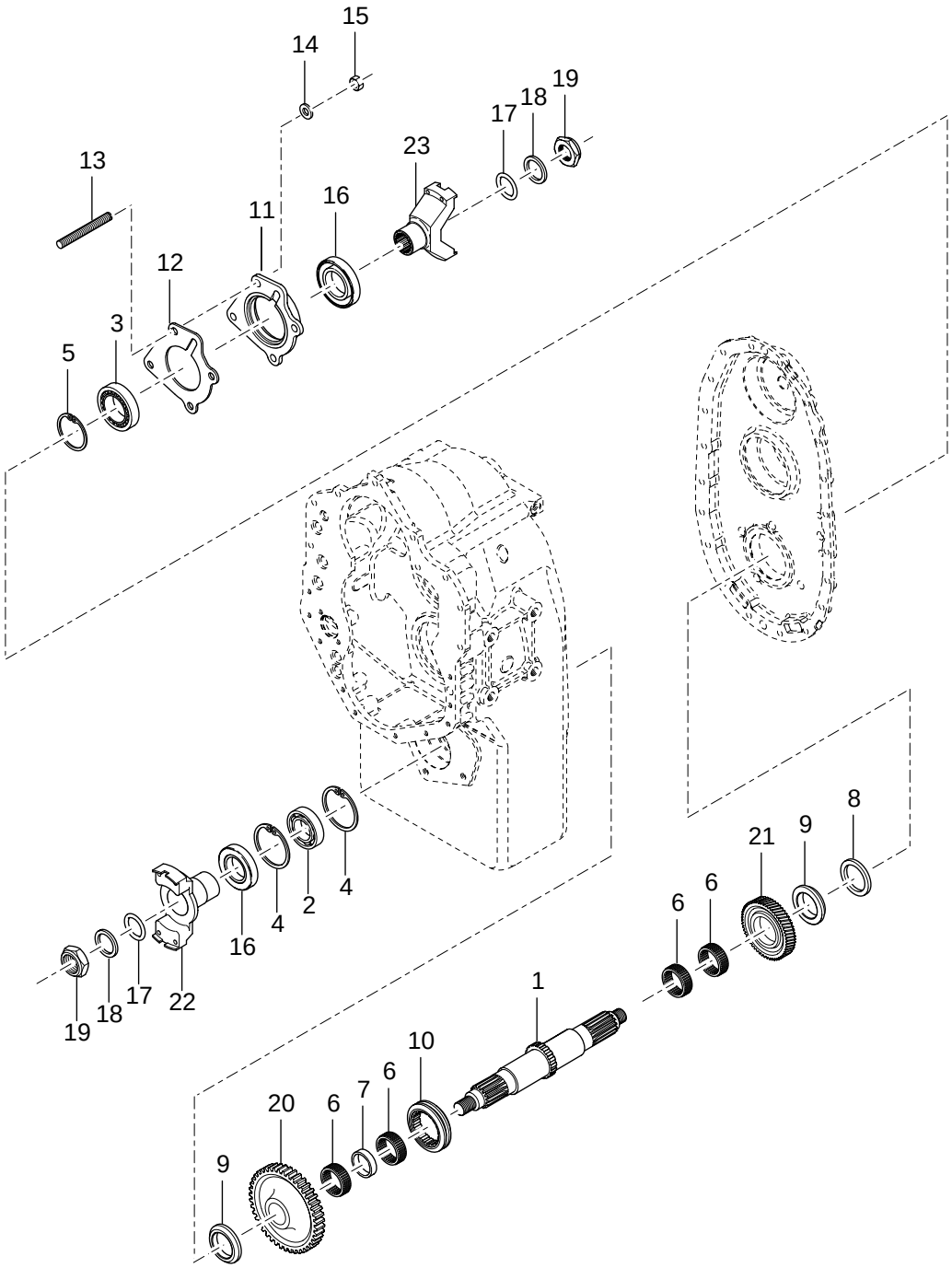
GROUP - IDLER SHAFT (USED IN 3 SPEED STANDARD RATIO)

Item	Description	Quantity
1	Shaft - Idler	1
2	Bearing - Ball	1
3	Snap ring - Bearing	1
4	Bearing - Roller	1
5	Nut - Bearing	1
6	Washer - Bearing nut	1
7	Spacer - Idler shaft gear	1
8	Snap ring	1
9	Gear - Idler shaft	1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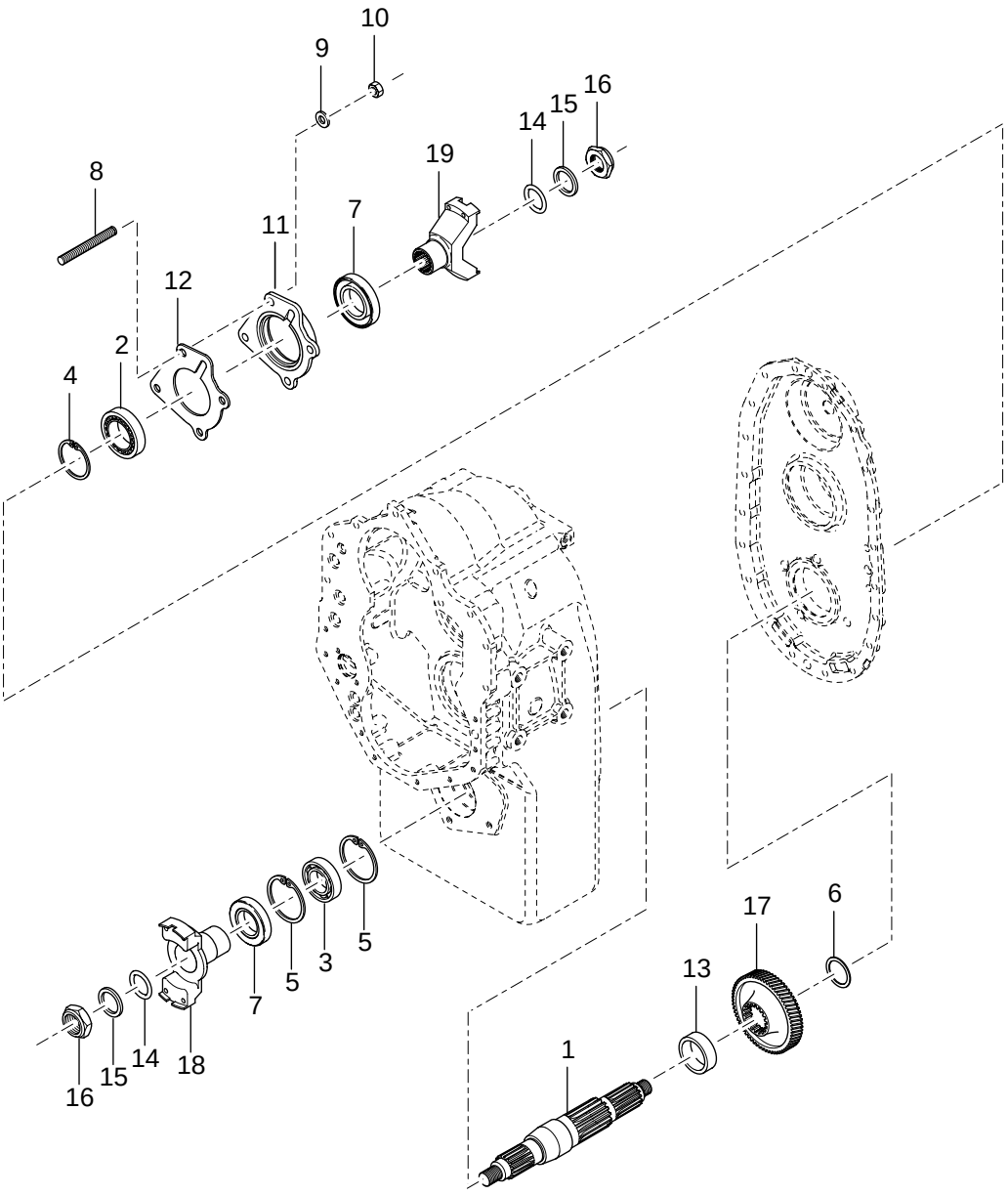
GROUP - OUTPUT SHAFT (6 SPEED)

Item	Description	Quantity
1	Shaft - Output	1
2	Bearing - Output shaft front	1
3	Bearing - Output shaft rear	1
4	Snap ring - Front bearing retaining	2
5	Ring - Output shaft rear bearing retaining	1
6	Bearing - Hi/Low gear	4
7	Spacer - Bearing	1
8	Spacer - Bearing	1
9	Washer - Gear thrust	2
10	Hub - Range shift	1
11	Cap - Rear bearing	1
12	Gasket - Rear bearing cap	1
13	Stud - Rear bearing cap	4
14	Lockwasher - Rear bearing cap stud	4
15	Nut - Rear bearing cap stud	4
16	Seal - Output shaft	2
17	“O”-ring - Output flange	2
18	Washer - Output flange	2
19	Nut - Output flange	2
20	Gear - Low range	1
21	Gear - High range	1
22	Flange - Output front	1
23	Flange - Output rear	1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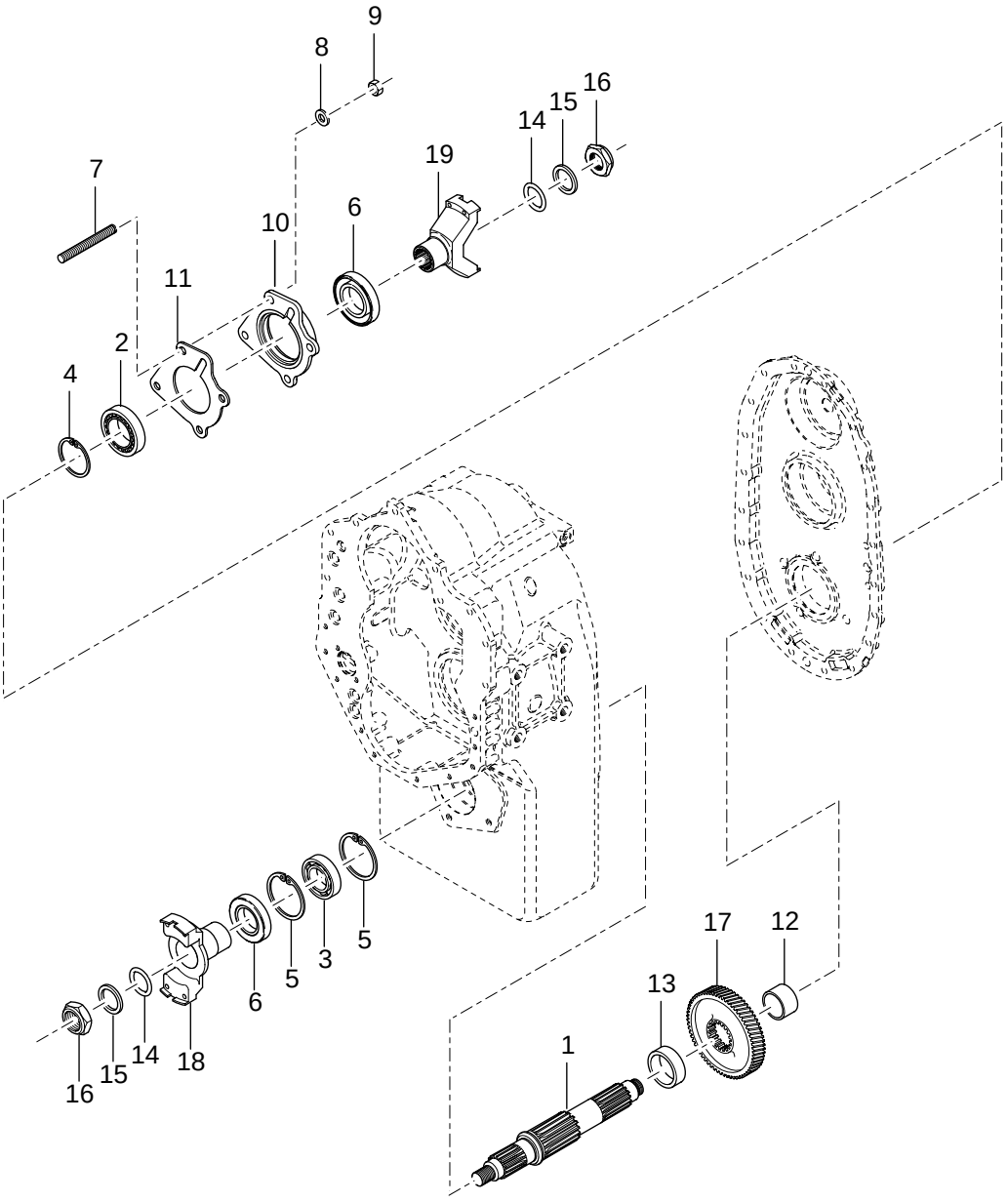
GROUP - OUTPUT SHAFT (3 SPEED STANDARD RATIO)

Item	Description	Quantity
1	Shaft - Output	1
2	Bearing - Output shaft rear	1
3	Bearing - Output shaft front	1
4	Ring - Output shaft rear bearing	1
5	Ring - Output shaft front bearing retaining	2
6	Washer - Output shaft rear bearing	1
7	Seal - Output shaft	2
8	Stud - Bearing cap	4
9	Lockwasher - Bearing cap screw	4
10	Nut - Stud	4
11	Cap - Output shaft rear bearing	1
12	Gasket - Output bearing cap	1
13	Spacer - Gear	1
14	“O”-ring - Flange	2
15	Washer - Flange	2
16	Nut - Flange	2
17	Gear - Output	1
18	Front - Flange	1
19	Rear - Flange	1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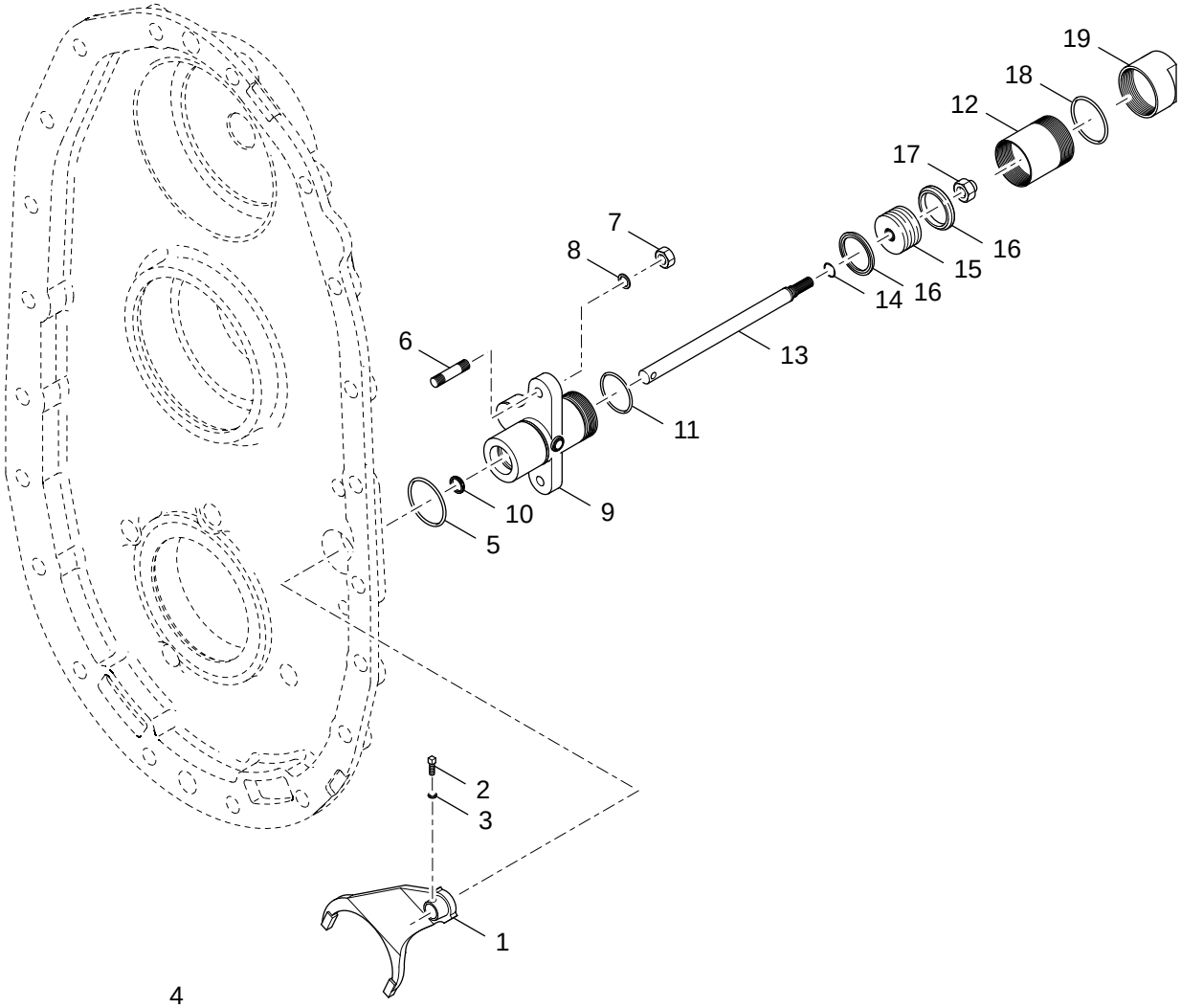
GROUP - OUTPUT SHAFT (3 SPEED DEEP RATIO)

Item	Description	Quantity
1	Shaft - Output	1
2	Bearing - Output shaft rear	1
3	Bearing - Output shaft front	1
4	Ring - Output shaft rear	1
5	Ring - Output shaft front bearing retaining	2
6	Seal - Output shaft	2
7	Stud - Bearing cap	4
8	Lockwasher - Bearing cap screw	4
9	Nut - Stud	4
10	Cap - Output shaft rear bearing	1
11	Gasket - Output bearing cap	1
12	Spacer - Gear	1
13	Spacer - Gear	1
14	“O”-ring - Flange	2
15	Washer - Flange	2
16	Nut - Flange	2
17	Gear - Output	1
18	Front - Flange	1
19	Rear - Flange	1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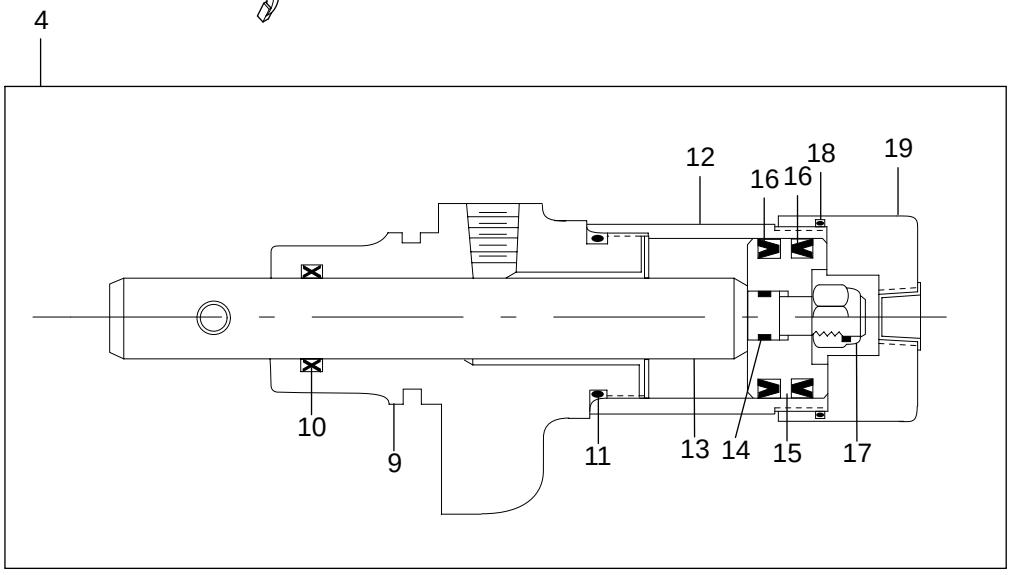
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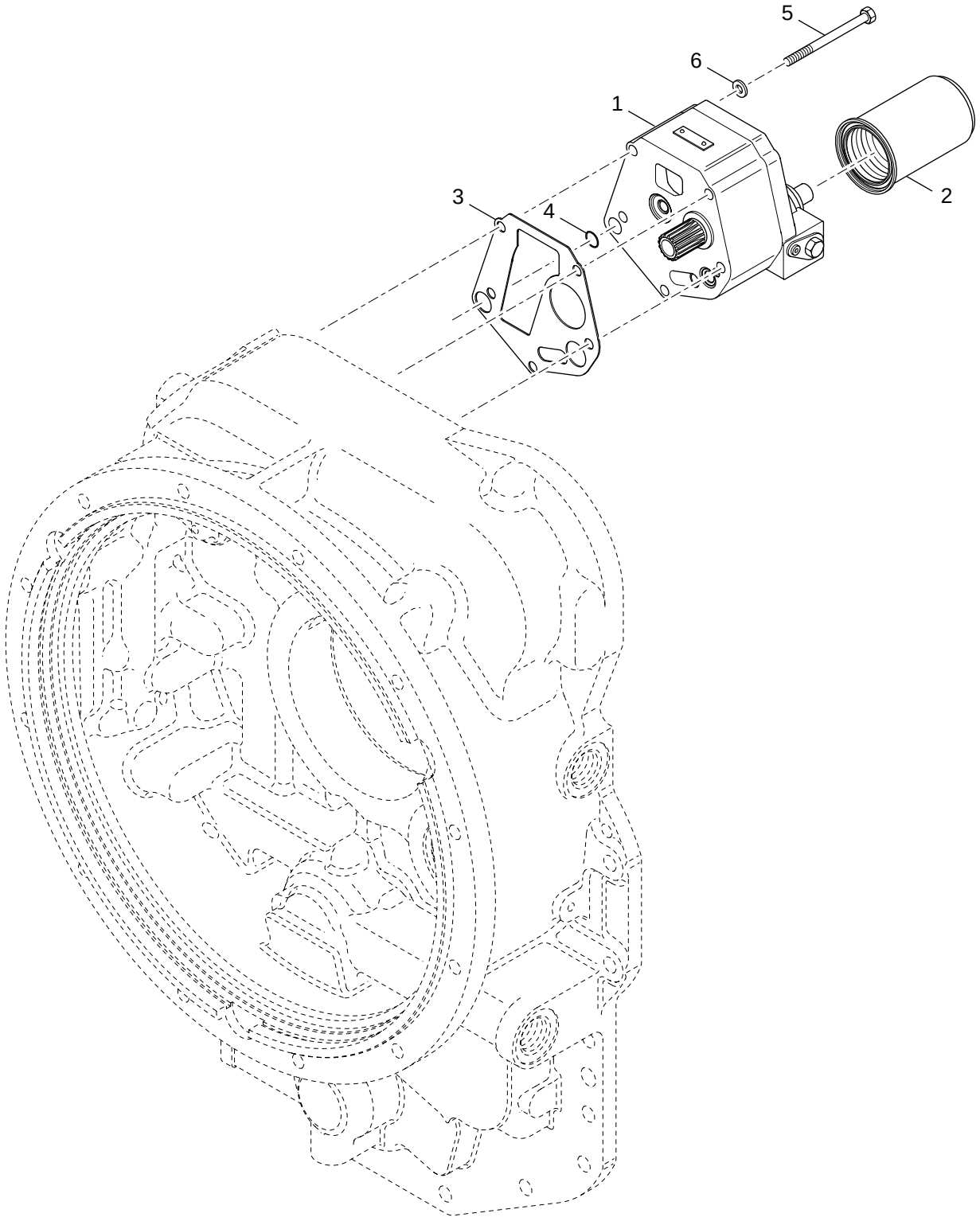
GROUP - HI & LOW RANGE SHIFT CONTROL

Item	Description	Quantity
1	Fork - Shift	1
2	Screw - Shift fork	1
3	Lockwasher - Shift fork	1
4	Assembly - Air shift cylinder	1
5	“O”-ring	1
6	Stud - Pump mounting	2
7	Nut	2
8	Lockwasher	2
9	Body - Cylinder	1
10	Seal - Piston rod	1
11	“O”-ring - Seal	1
12	Tube - Cylinder	1
13	Rod - Piston	1
14	“O”-ring	1
15	Piston	1
16	Cup - Seal	2
17	Nut	1
18	“O”-ring	1
19	Cap - Cylinder end	1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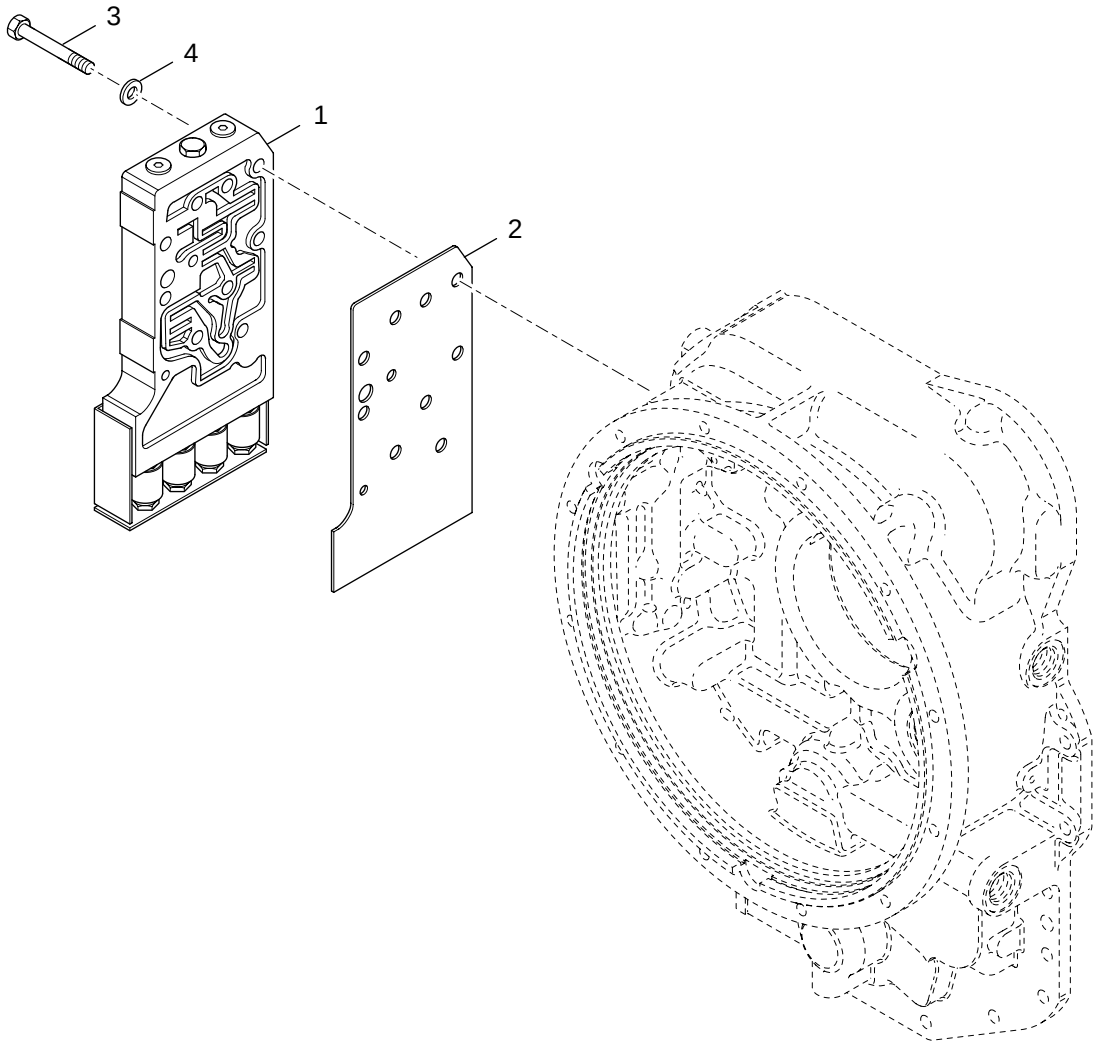
GROUP - CHARGING PUMP & FILTER

Item	Description	Quantity
1	Pump - Charging	1
2	Assembly - Hydraulic spin on filter	1
3	Gasket - Pump assembly to converter housing	1
4	“O”-ring	1
5	Screw - Pump mounting	5
6	Lockwasher - Pump mounting screw	5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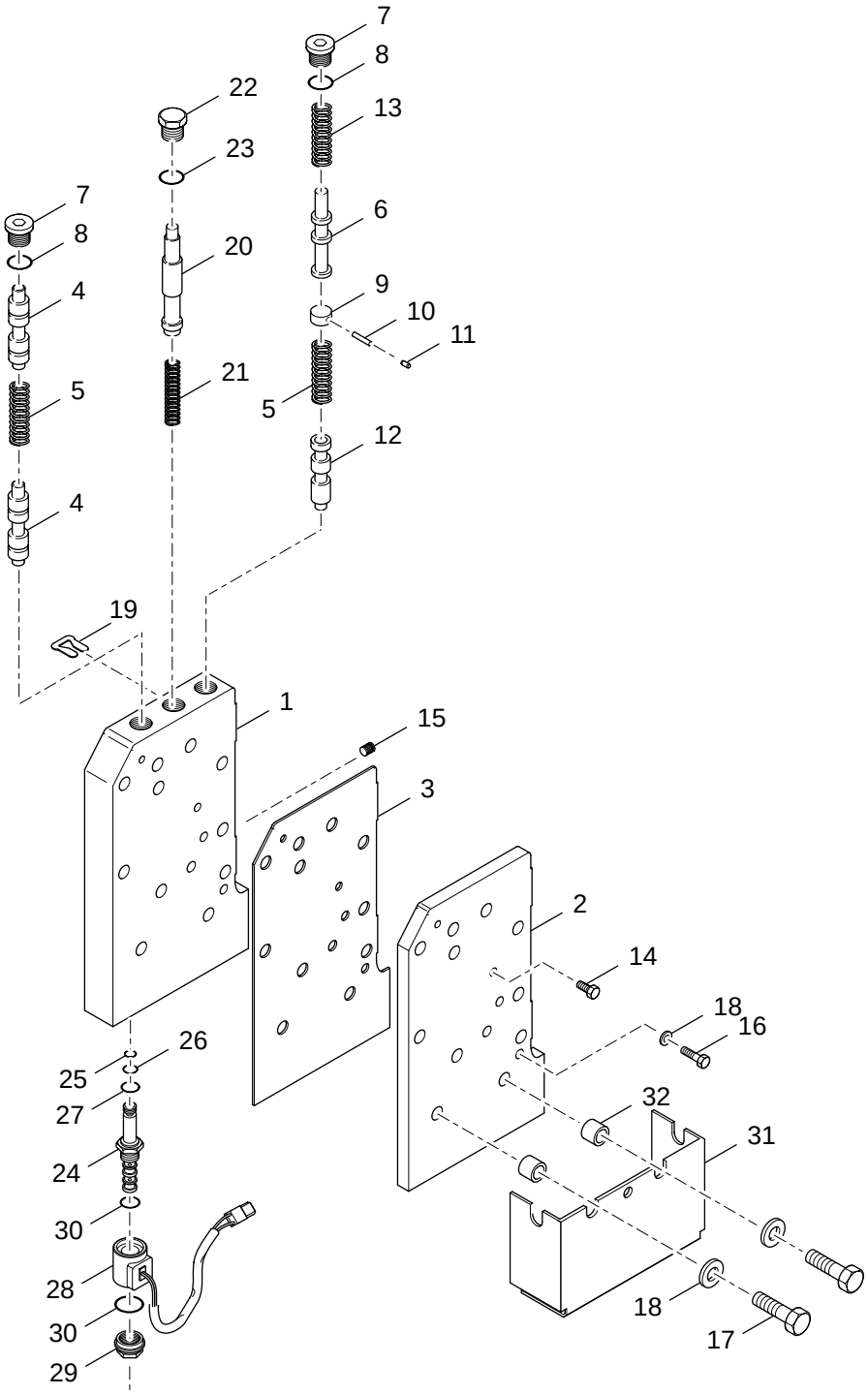
GROUP - ELECTRIC CONTROL VALVE MOUNTING

Item	Description	Quantity
1	Assembly - Electric control valve	1
2	Gasket - Control valve to front cover	1
3	Screw - Valve to converter housing	9
4	Lockwasher - Valve to converter housing screw	9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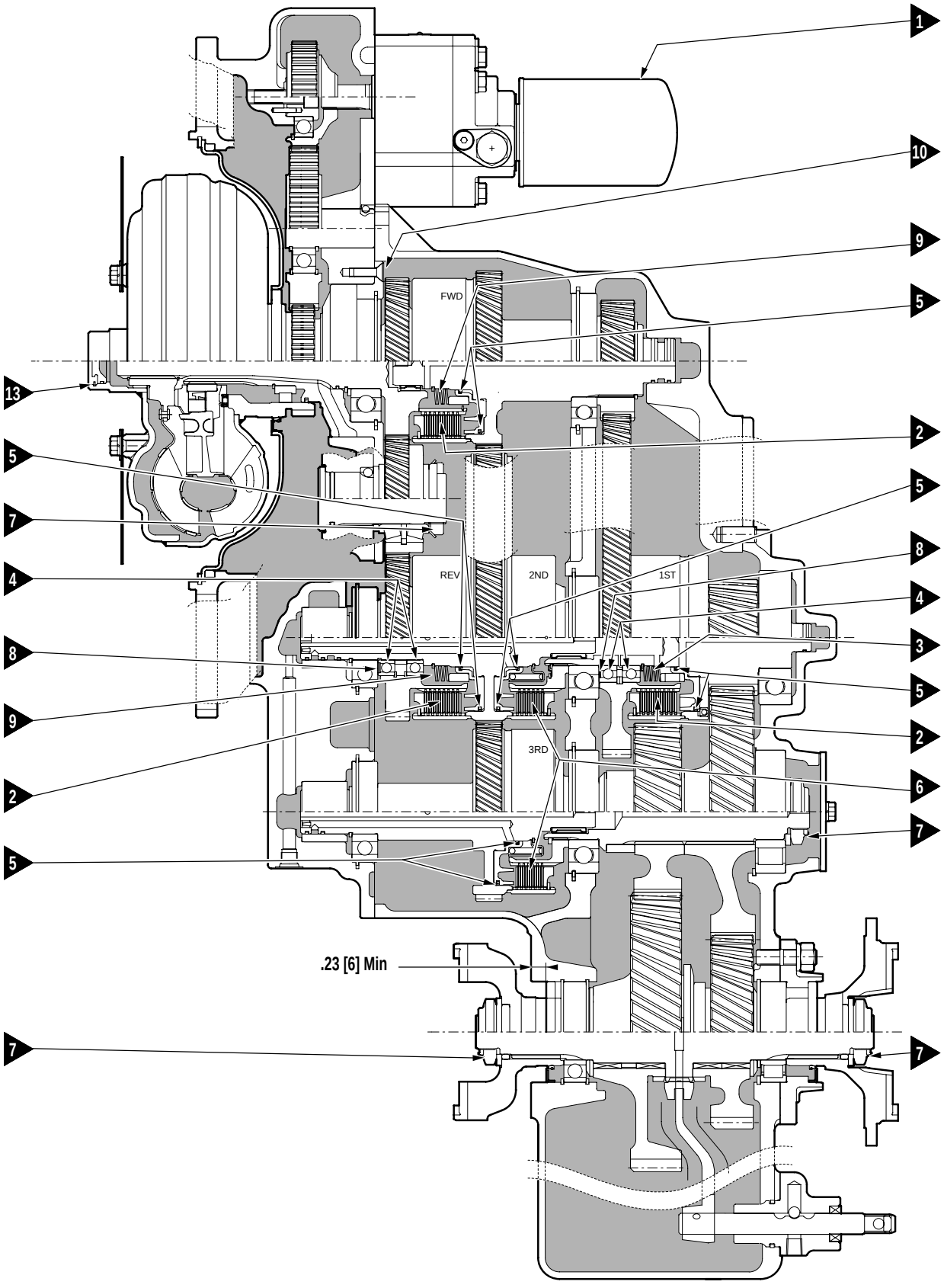
GROUP - ELECTRIC CONTROL VALVE ASSEMBLY

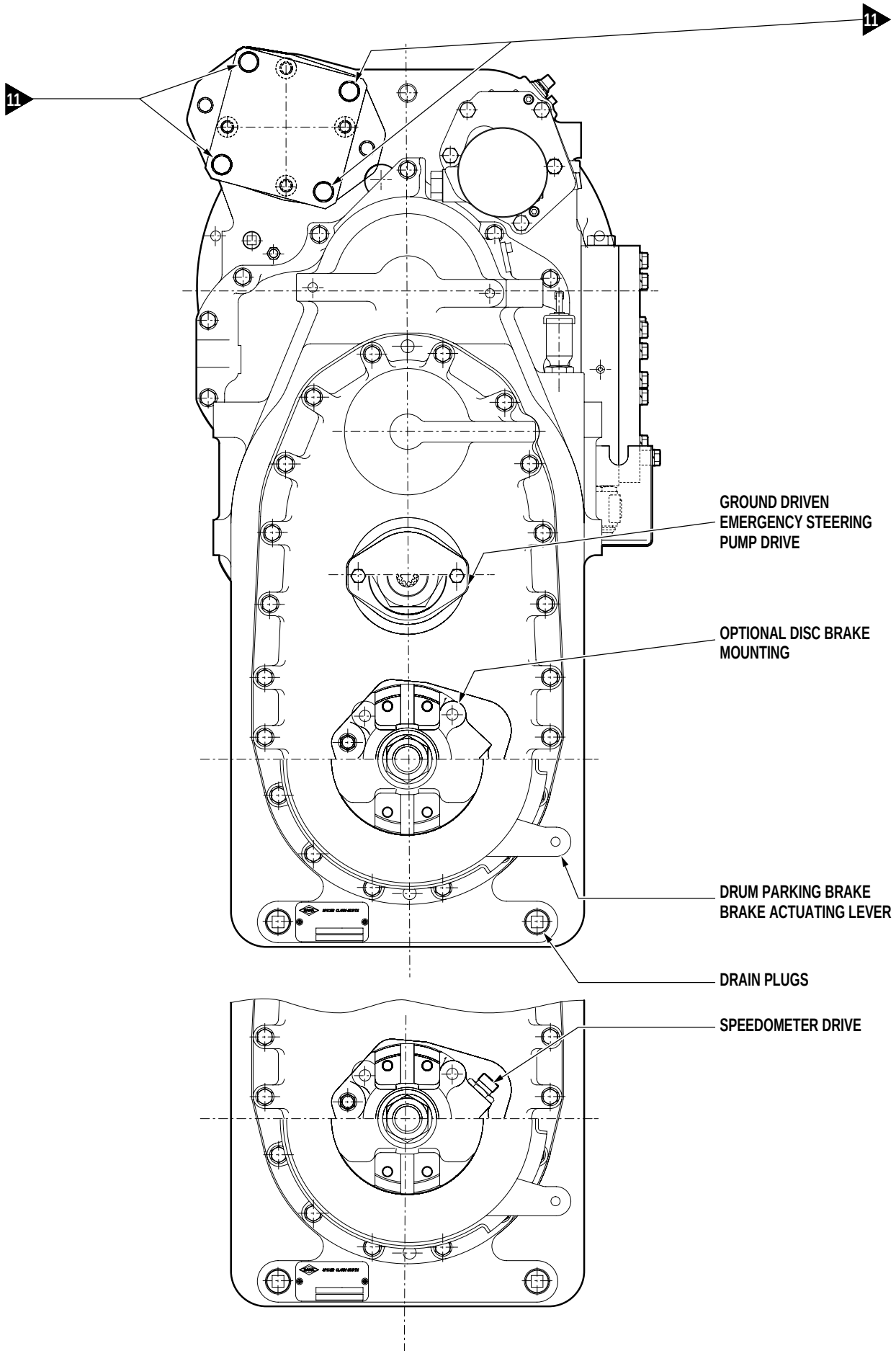
Item	Description	Quantity
1	Housing control valve	1
2	Cover - Control valve	1
3	Gasket - Control valve cover	1
4	Spool - Forward and reverse shift	2
5	Spring	2
6	Spool - Range (3rd)	1
7	Valve housing plug	2
8	Valve housing plug “O”-ring	2
9	Spool stop	1
10	Pin	1
11	Plug stop	1
12	Spool - Range (1st and 2nd)	1
13	Spring	1
14	Pipe plug	8
15	Plug	1
16	Screw	1
17	Screw	2
18	Lockwasher	3
19	Stop - Spool	1
20	Forward and reverse declutching spool	1
21	Spring - Declutch	1
22	Plug	1
23	“O”-ring - Plug	1
24	Cartridge - Ball valve	4
25	“O”-ring - Cartridge	4
26	“O”-ring - Cartridge	4
27	“O”-ring - Cartridge	4
28	Coil 12V	4
29	Nut - Solenoid	4
30	“O”-ring	8
31	Cover - Solenoid	1
32	Spacer - Cover	2

9. ASSEMBLY INSTRUCTIONS

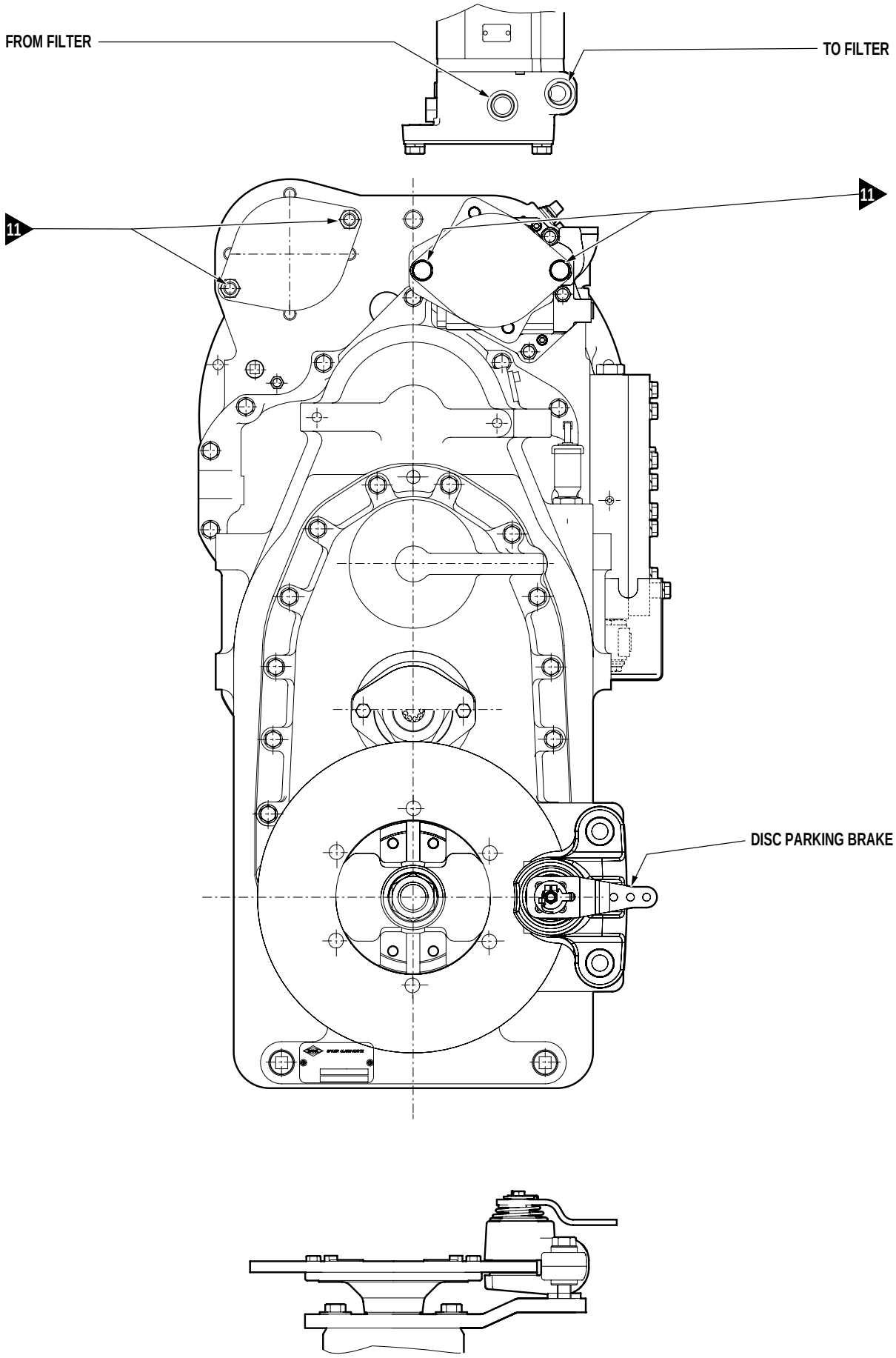
9. ASSEMBLY INSTRUCTIONS (CONTINUED)



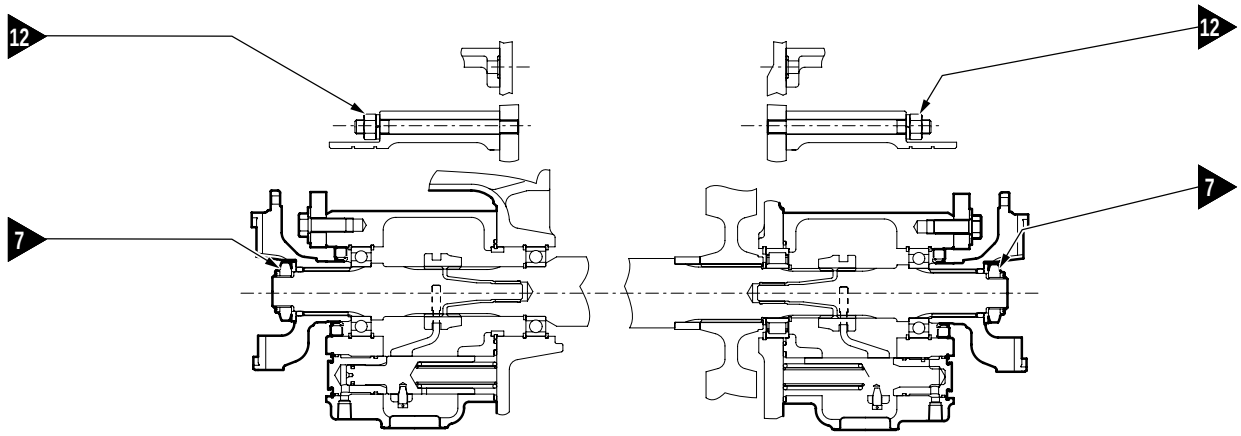
9. ASSEMBLY INSTRUCTIONS (CONTINUED)



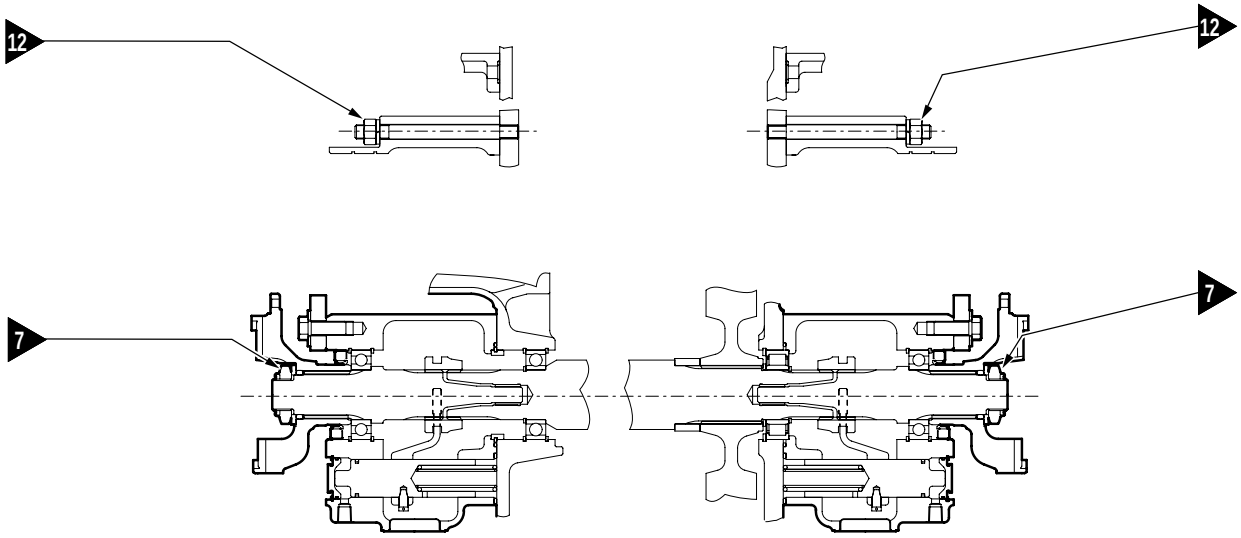
9. ASSEMBLY INSTRUCTIONS (CONTINUED)



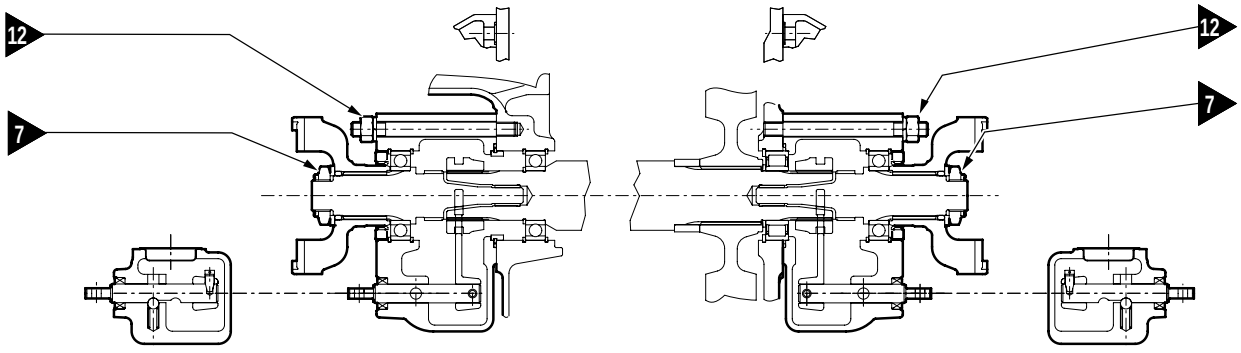
9. ASSEMBLY INSTRUCTIONS (CONTINUED)



HYDRAULIC DISCONNECT
FRONT - AND REAR OUTPUT



AIR DISCONNECT
FRONT - AND REAR OUTPUT



MANUAL DISCONNECT
FRONT - AND REAR DISCONNECT

9. ASSEMBLY INSTRUCTIONS (CONTINUED)

All lead in chamfers for oil seals, piston rings, and “O”-rings must be smooth and free from burrs. Inspect at assembly.

Lubricate all piston ring grooves and “O”-rings with oil before assembly.

Apply a thin coating of grease between seal lips on lip type seals prior to assembly.

Use only precoated pipe plugs. On uncoated pipe plugs apply a light coat of Loctite no. 592.

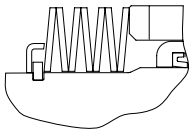
After assembly of parts using Loctite, there must not be any free or excess material which might enter the oil circuit.

Apply a light coat of Loctite no. 262 or no. 270 to all thru hole stud holes.

1. Tighten oil filter to 20-25 lbf.ft [27-34 N.m].

2. Fwd. and rev. with standard piston & low clutch. 8 Outer steel discs and 8 inner friction discs. Insert one (1) Steel disc. Insert one (1) friction disc. Alternate steel and friction discs until proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

3. Low clutch springs concave side of first belleville spring to be placed against clutch piston. Remaining six springs of each clutch to be stacked alternately reversed as shown.



4. Must be loose internal fit bearing with a no. 3 etched on the bearing.

5. Shields must be sized prior to assembly.

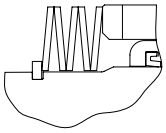
6. Two clutches (2nd & 3rd). 6 Outer steel discs and 6 inner friction discs.

   Start with outer steel disc alternate friction and steel.

7. Tighten to 200 - 250 lbf.ft [271.2 - 339.0 N.m].

8. Shielded bearings, be sure that bearing shield is on the outside.

9. Forward and reverse clutch springs concave side of first belleville spring to be placed against clutch piston. Remaining four springs of each clutch to be stacked alternatly reversed as shown.



9. ASSEMBLY INSTRUCTIONS (CONTINUED)

10 Stator support screw assembly:

1. Clean stator support mounting surface and tapped holes with solvent. Dry thoroughly. Being certain tapped holes are clean and dry.
2. Install 6 special stator support screws. Tighten screws to 12 - 16 lbf.ft [16.3 - 21.7 N.m] torque.

Note

ASSEMBLY OF STATOR SUPPORT TO CONVERTER HOUSING MUST BE COMPLETED WITHIN A 15 MINUTE PERIOD FROM START OF SCREW INSTALLATION. THE SPECIAL SCREW IS TO BE USED FOR ONE INSTALLATION ONLY. IF SCREW IS REMOVED FOR ANY REASON IT MUST BE REPLACED. THE LOCTITE LEFT IN THE HOLES MUST BE REMOVED WITH THE PROPER TAP AND CLEANED WITH SOLVENT. DRY HOLE THOROUGHLY AND USE A NEW SCREW FOR REINSTALLATION.

11 Torque screws of pump cover up to 20 - 25 lbf.ft [27 - 34 N.m].

12 Tighten to 91 - 100 lbf.ft [123.4 - 135.6 N.m].

13 Snap ring is to be assembled with sharp edges to front.

Figure 1

Front view of the T20000 series long drop transmission.The transmission being disassembled is the 6-speed version.

Figure 4

Remove pressure regulating valve and charging pump bolts.

Figure 2

Loosen filter assembly.

Figure 5

Remove valve and pump assembly.

Figure 3

It is recommended a small pan be used to catch the oil left in the filter element. Remove filter element.

Figure 6

Remove drive plate mounting screws and washers.

Figure 7
Remove drive plate and backing ring.

Figure 8
Remove impeller cover bore plug retainer ring.

Figure 9
Using two small screw drivers as shown, remove plug.

Figure 10
Though bore plug hole, remove turbine retaining ring.

Figure 11
Remove torque converter assembly.

Figure 12
Remove turbine locating ring.

Figure 13
Using slots provided in converter housing. Remove oil baffle retaining ring.

Figure 16
Remove idler gear and bearing assembly.

Figure 14
Baffle and sealing ring removed.

Figure 17
Remove pump drive idler gear locating ring.

Figure 15
Remove pump drive idler gear retaining ring.

Figure 18
From the rear through the pump drive hole, remove pump drive bearing support screw.
See figure 281.

Figure 19
From the front, tap pump drive gear and bearing support from housing.

Figure 22
From the front, tap pump drive gear and bearing from housing.

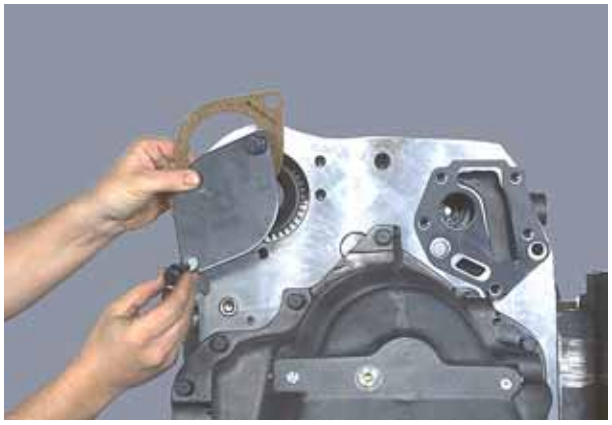


Figure 20
From the rear, remove pump hole cover, screws, lockwashers and gasket.

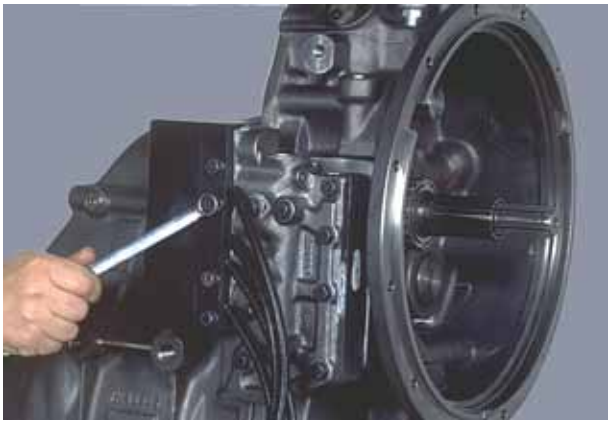


Figure 23
Remove solenoid protection cover screw and lockwashers.

Figure 21
Remove auxiliary pump drive bearing support screws. See figure 284.

Figure 24
Protection cover removed.

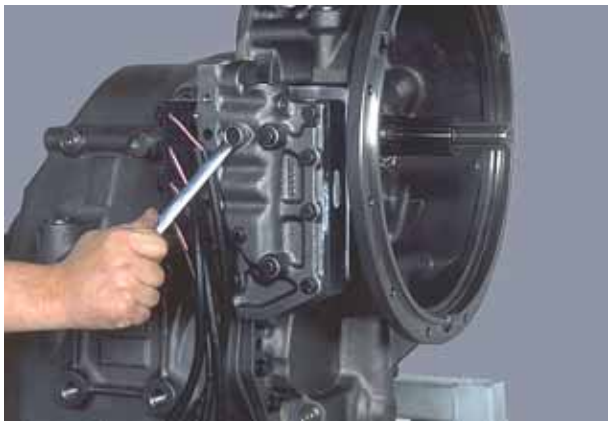


Figure 25
Remove control valve bolts and lockwashers.

Figure 28
Support converter housing with a chain hoist. Remove remaining bolt.

Figure 26
Remove control valve and gasket.

Figure 29
Separate converter housing from transmission case assembly.
NOTE: Reverse and 2nd and 3rd clutch will remain in converter housing.

Figure 27
Remove all bolts but one securing transmission to converter housing.

Figure 30
Using spreading type snap ring pliers, spread ears on the reverse clutch front bearing retaining ring.

Figure 31
Holding snap ring open pry reverse and 2nd clutch assembly from converter housing.

Figure 34
Remove output shaft front flange nut, washer, “O”-ring and flange.

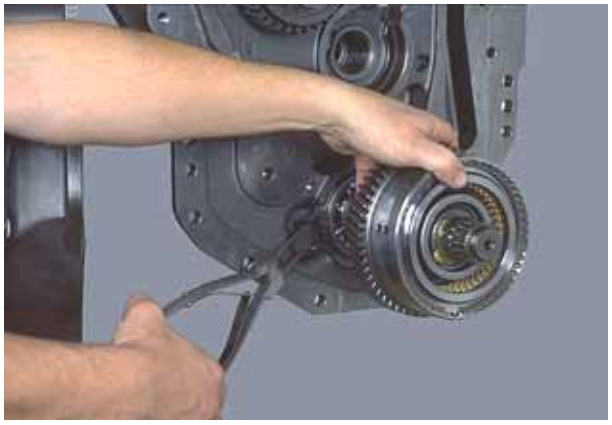


Figure 32
Using spreading type snap ring pliers, spread ears on the 3rd clutch front bearing retaining ring.

Figure 35
Remove output shaft rear flange nut, washer, “O”-ring and flange.

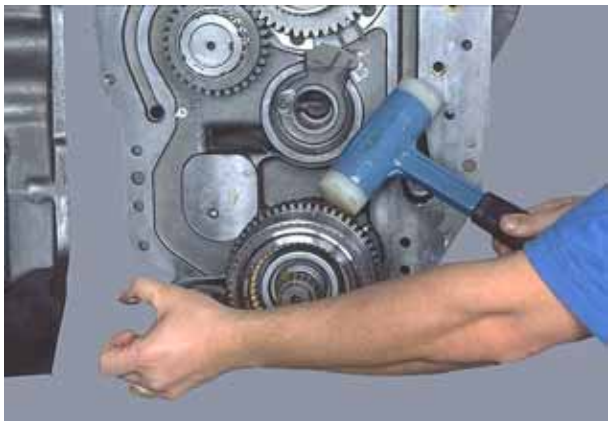


Figure 33
Holding snap ring open tap 3rd clutch from converter housing.

Figure 36
Remove pump hole cover, cover gasket screws and lockwashers.

Figure 37
Remove output shaft rear bearing cap nuts and lockwashers.

Figure 40
Remove piston rod nut.

Figure 38
Output shaft rear bearing cap removed.

Figure 41
Remove shift cylinder mounting nuts and lockwashers.

Figure 39
Remove shift cylinder end cap.

Figure 42
Shift cylinder removed.

Figure 43
Remove rear cover screws and lockwashers.

Figure 44
Using pry slots provided, pry cover from transmission housing. Using a shoft hammer tap on idler and output shafts to prevent cover from binding.

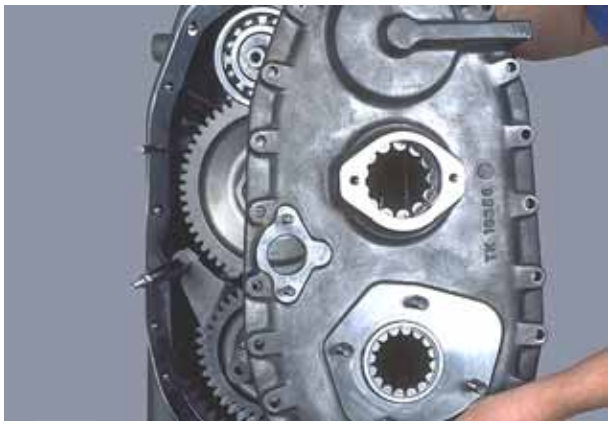


Figure 45
Rear cover removed.**NOTE**: output and idler shaft bearing outer races remaining in cover.

Figure 46
Remove low clutch rear bearing.

Figure 47
Remove 3rd clutch disc and retaining ring.

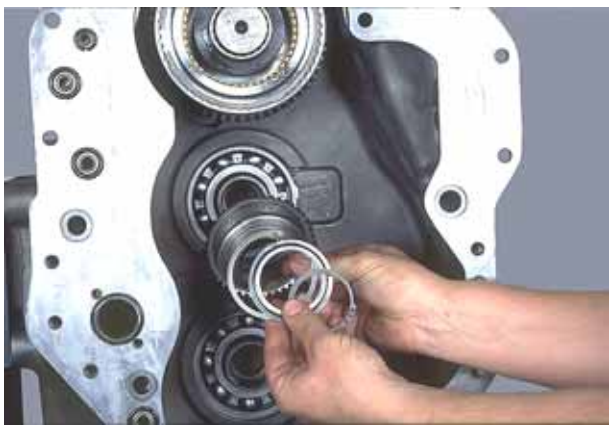


Figure 48
Remove 2nd clutch disc hub, retaining ring, retaining ring retainer and retainer locating ring.

Figure 49

Open ears on idler shaft front bearing locating ring so that it is out of the groove.

Figure 52

Tap the rear sufficiently so that bearing groove is past snap ring i.e. that snap ring remain in open position on the bearing outer diameter when it is released.

Figure 50

Tap to the rear sufficiently so that the bearing groove is past snap ring i.e. that snap remain in open position on the bearing outer diameter when it is released.
NOTE: If bearing seems difficult to move recheck locating ring, being sure ring is clear of the ring groove.

Figure 53

Remove the low (1st) clutch and the idler shaft together.

Figure 51

Open ears on low shaft front bearing locating rings so that it is out of the groove.

Figure 54

Remove shift fork.

Figure 55
From the front tap output shaft from the front bearing, bearing remains in transmission case.

Figure 58
From the front tap output shaft bearing from housing.

Figure 56
Remove output shaft assembly from housing.

Figure 59
Open ears on forward shaft rear bearing locating ring.

Figure 57
Remove output shaft front bearing locating ring.

Figure 60
While holding locating ring open, use a hammer puller to remove forward shaft and clutch assembly. Internal THD M10 x 1.5 deep 15mm.

Figure 61

Remove low gear and hub, low shaft front bearing and clutch gear outer bearing.

Figure 64

Turn clutch over. Remove inner and outer clutch discs.Do not mix low clutch friction discs with friction discs in other clutches.

Figure 62

Remove end plate retainer ring.

Figure 65

Remove low speed gear bearing spacer.

Figure 63

Remove end plate.

Figure 66

Remove low speed gear inner bearing.

Figure 67

Remove clutch piston return spring. A 1-1/2 x 1 sleeve with a portion removed is recommended for removing the clutch piston spring, washer and retainer ring. Sleeve shown is a common pipe with a 1-1/1 x (39,0 x 26,0 mm) opening. The pipe is 6 x 3-1/4 x 2- 3/4 (155,0 x 85,0 x 78,0 mm). Compress spring retainer washer. Through opening remove spring retainer snap ring. Release tension on spring retainer.

Figure 68

Remove snap ring retainer and retaining ring, disc spring and spacer.**NOTE**: Do not mix disc springs with any other disc springs as they are matched spring packs. SEE PAGE 10-60.

Figure 69

Turn clutch over and tap clutch shaft on a block of wood to remove clutch piston.

Figure 70

Remove clutch shaft piston ring.

Figure 71

Refer to the “Cleaning and Inspection” pages. The bleed valve in the clutch drum must be clean and free of any foreign material. Install clutch piston outer seal ring. **NOTE**: Ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating clutch while holding a round object against the new seal ring. Rotate piston until seal ring is flush with outer diameter of piston.

Figure 72

Install clutch piston inner seal ring and size as described in figure 71.

Figure 73

Position piston in low clutch drum as shown. Use caution as not to damage inner and outer piston scaling rings.

Figure 74

Install piston spring spacer and piston return springs. First spring with large diameter toward spacer (see figure 77). Alternate seven (7) springs. See note in figure 68.

Figure 75

Position spring snap ring. Compress spring and install snap ring.

Figure 76

Install snap ring retainer.

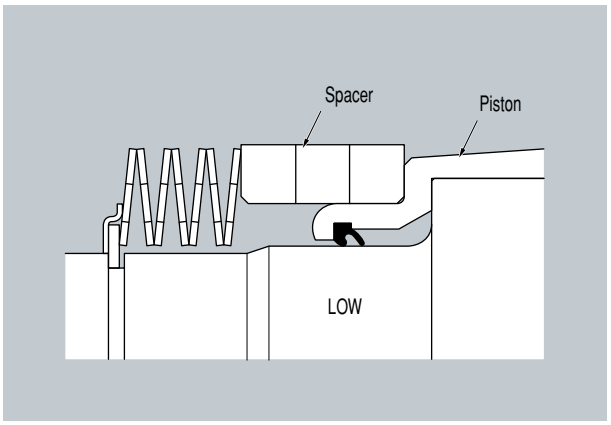


Figure 77

Figure 80
Install clutch disc end plate.

Figure 78
Install one steel disc.

Figure 81
Install end plate retainer ring.

Figure 79
Install one friction disc. **NOTE**: the friction discs in the low clutch has a higher co-efficient rating than the friction discs in the other clutches therefore the discs must not be mixed.The low clutch friction disc has a yellow make of non-soluble paint on the outer diameter for permanent identification.Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston in steel last disc installed is friction.

Figure 82
Install low speed gear inner bearing.

Figure 83
Install low speed gear bearing spacer.

Figure 86
Install low shaft font bearing with bearing groove up.

Figure 84
Install clutch driven gear and hub into clutch drum.Align splines on clutch hub with internal teeth of friction discs. Tap gear into position.
Do not force this operation. Gear splines must be in full position with internal teeth of all friction discs.

Figure 87
Install low shaft sealing ring.

Figure 85
Install low speed gear outer bearing.
NOTE: outer bearing has a shield in it, this shield must be up.

Figure 88
Remove clutch shaft piston rings.

Figure 89
Remove clutch shaft front bearing retainer ring.

Figure 90
Remove clutch shaft front bearing.

Figure 91
Pry reverse gear from clutch assembly far enough to use a gear puller.

Figure 92
Remove reverse clutch gear and outer bearing.

Figure 93
Remove clutch gear bearing spacer.

Figure 94
Remove end plate retainer ring.

Figure 97
Remove clutch gear inner bearing.

Figure 95
Remove end plate.

Figure 98
Compress piston return disc springs. Remove return spring retainer ring.

Figure 96
Remove inner and outer discs.

Figure 99
Remove piston return disc springs and piston spacer. See note in figure 68.

Figure 100
Remove clutch piston.2nd being disassembled.

Figure 101
Remove end plate retainer ring.

Figure 104
Compress piston return spring. Remove retainer ring.

Figure 102
Remove end plate.

Figure 105
Remove return spring, spring retainer and retainer ring.

Figure 103
Remove inner and outer clutch discs.

Figure 106
Remove clutch piston. Reverse and 2nd clutch reassembly 2nd being assembled.

Figure 107

Refer to the “Cleaning and Inspection” pages.
The bleed valve in the clutch piston must be clean and free of any foreign material.
Install clutch piston outer seal ring.
Size as explained in figure 71.

Figure 110

Compress return spring and install retainer ring.

Figure 108

Install clutch piston inner seal ring.
Size explained in figure 71.
Install clutch piston in clutch drum.
Use caution as not to damage sealing rings.

Figure 111

Install one steel disc.

Figure 109

Position piston return spring, spring retainer and retainer ring.

Figure 112

Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is a friction disc.

Figure 113
Install end plate and retainer ring.

Figure 114

Refer to the “Cleaning and Inspection” pages.
The bleed valve in the clutch piston must be clean and free of any foreign material. Install clutch piston outer seal ring.
Size as explained in figure 71.

Figure 117

Position spring snap ring.
Compress spring.
Install snap ring.

Figure 115

Install clutch piston inner seal ring.
Size as explained in figure 71.
Install clutch piston in clutch drum.
Use caution as not to damage sealing rings.

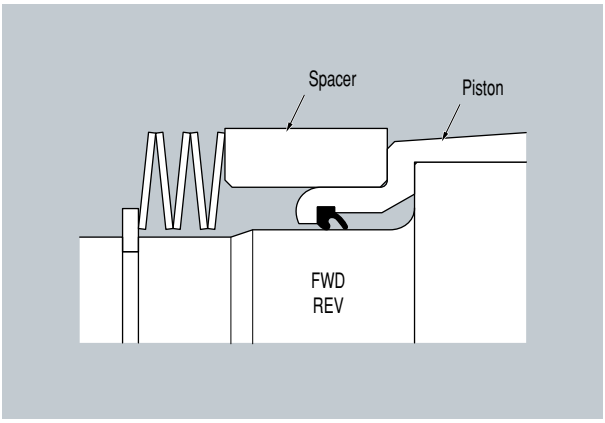


Figure 118

Figure 116

Position spring spacer and piston return springs.
First spring with large diameter toward spacer, see figure 118. Alternate five (5) springs.
See note in figure 68.

Figure 119

Install one steel disc.

Figure 120

Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is a friction disc.

Figure 123

Install clutch gear inner bearing.
NOTE: this bearing does not have a shield in it.

Figure 121

Install end plate.

Figure 124

Install clutch gear bearing spacer.

Figure 122

Install end plate retainer ring.

Figure 125

Install reverse gear into clutch drum.
Align splines on reverse gear with internal teeth of friction discs. Do not force this operation. Gear splines must be in full position with internal teeth of all friction discs.

Figure 126

Install clutch gear outer bearing.
NOTE: outer bearing has a shield in it, this shield must be up.

Figure 129

Install clutch shaft piston rings.

Figure 127

Install clutch shaft front bearing.
NOTE: bearing outer diameter locating groove must be up.

Figure 128

Install bearing retainer ring.

Figure 130
Remove end plate retainer ring.

Figure 133
Compress piston return spring and spring retainer. Remove retainer ring.

Figure 131
Remove end plate.

Figure 134
Remove return spring, spring retainer and retainer ring.

Figure 132
Remove inner and outer discs.

Figure 135
Remove clutch piston.

Figure 136
Remove clutch shaft piston rings.

Figure 137
Remove clutch shaft front bearing retainer ring.

Figure 138
Remove clutch shaft front bearing.

Figure 139

Refer to the “Cleaning and Inspection” pages. The bleed valve in the clutch drum must be clean and free of any foreign material. Install clutch shaft front bearing. **NOTE**: bearing outer diameter locating ring groove must be up.

Figure 142

Install clutch piston outer seal ring. Size as explained in figure 71.

Figure 140

Install clutch shaft front bearing retainer ring.

Figure 143

Install clutch piston inner seal ring.
Size as explained in figure 71.
Install clutch piston in clutch drum.
Use caution as not to damage sealing rings.

Figure 141

Install clutch shaft piston rings.

Figure 144

Position piston return spring, spring retainer and retaining ring.

Figure 145
Compress return spring and install retainer ring.

Figure 148
Install end plate.

Figure 146
Install on steel disc.

Figure 149
Install end plate retainer ring.

Figure 147
Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is a friction disc.

Figure 150
Remove end plate retainer ring.

Figure 153
Compress piston return disc springs.
Return spring retainer ring.

Figure 151
Remove end plate.

Figure 154
Remove piston return disc springs and piston spacer. See note in figure 68.

Figure 152
Remove inner and outer clutch discs.

Figure 155
Remove clutch piston.

Figure 156
Remove forward clutch shaft piston rings.

Figure 159
Remove forward clutch shaft rear bearing.

Figure 157
Remove 1st drive gear retaining ring.

Figure 158
Remove 1st drive gear.

Figure 160

Refer to the “Cleaning and Inspection” pages. The bleed valve in the clutch drum must be clean and free of any foreign material. Install forward clutch shaft rear bearing. **NOTE**: bearing outer diameter locating ring groove must be down.

Figure 163

Install forward clutch shaft piston rings.

Figure 161

Install 1st drive gear.
NOTE: with hub of gear down.

Figure 164

Install clutch piston outer seal ring.
Size as explained in figure 71.

Figure 162

Install 1st drive gear retaining ring.

Figure 165

Install clutch piston inner seal ring.
Size as explained in figure 71.
Install clutch piston in clutch drum, use caution as not to damage sealing rings.

Figure 166

Position spring spacer and piston return springs. First spring with large diameter toward spacer, see figure 168. Alternate five (5) springs: see note in figure 68.

Figure 167

Position spring nap ring. Compress spring. Install snap ring.

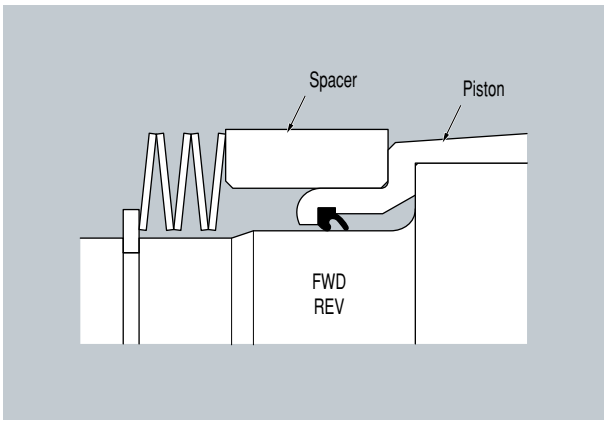


Figure 168

Figure 169

Install one steel disc.

Figure 170

Install one friction disc. Alternate steel and friction discs, until the proper amount of discs are installed. First disc next to the piston in steel, last disc installed is a friction disc.

Figure 171

Install end plate.

Figure 172
Install end plate retainer ring.

Figure 173
Straighten tang on reverse idler bearing retainer nut lockplate.

Figure 176
Remove idler gear and outer taper bearing from idler shaft.

Figure 174
Remove idler shaft bearing retainer nut.
Use TG 1304-54. See section 12: “Service tools”.

Figure 177
Remove idler gear bearing spacer.

Figure 175
Remove idler shaft bearing retainer nut, lockplate.

Figure 178
Remove idler gear inner taper bearing.

Figure 179
Remove idler gear inner taper bearing spacer.

Figure 182
Remove stator support screws.

Figure 180
Remove idler shaft , use caution as not to lose shaft lock ball.

Figure 183
Tap stator support from converter housing.

Figure 181
Using spreader type pliers spread ears on the turbine shaft bearing snap ring.
Tap turbine shaft and baring from converter housing.

Figure 184
Remove oil sealing ring sleeve retainer and washer.
Remove sleeve lock.

Figure 185
Using a sleeve puller like the one shown, remove sleeve.

Figure 188
Remove turbine shaft oil sealing ring.

Figure 186
Remove support bearing retaining ring.

Figure 189
Remove turbine shaft bearing retaining ring and washer.

Figure 187
Remove bearing from support. Remove support oil seal ring.

Figure 190
Remove turbine shaft bearing.

Figure 191

Refer to the “Cleaning and Inspection” pages.
Press turbine shaft bearing into position.
Bearing groove must be down.

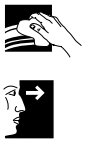


Figure 192

Position bearing spacer and bearing retaining ring.

Figure 193

Install new turbine shaft oil sealing ring.

Figure 194

Install new stator support oil sealing ring.
Press support bearing into position.
NOTE: bearing part number must be up.

Figure 195

When installing a new sleeve it is recommended a press or a driver be used to prevent damage to the sleeve and be sure the notch in the sleeve is aligned with sleeve lock notch.

Figure 196

Install sleeve lock and cap screw, tighten screw to specified torque (see torque chart).

Figure 197

Clean stator support mounting surface and tapped holes with solvent. Dry thoroughly, being certain tapped holes are clean and dry. Position support in converter housing aligning holes in support with holes in housing. Tap support into position.

Figure 200

With new “O”-ring on shaft , position idler shaft in converter housing. Tap shaft into position. Install lock ball.

Figure 198

Install 6 special stator support screws. Tighten screws to 12 - 16 lbs. Ft. (16.3 – 21.6 Nm.) torque. **NOTE**: assembly of the stator support to converter housing must be completed within a 15 minute period from start of screw installation. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The Loctite left in the holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a screw for reinstallation.

Figure 201

Install idler shaft spacer.

Figure 199

Spread ears on turbine shaft bearing retainer ring located in reaction member support. Tap turbine shaft and bearing into position, being certain bearing snap ring is in full position in snap ring groove.

Figure 202

Install idler gear inner taper baring in shaft with large diameter of taper down.

Figure 203
Position bearing spacer on shaft.

Figure 206
Install reverse idler baring retainer nut lockplate as shown.

Figure 204
Position idler gear on bearing with hub of gear up.

Figure 207
Install reverse idler bearing nut with chamfer down.

Figure 205
Install taper bearing on shaft with large diameter of taper up.

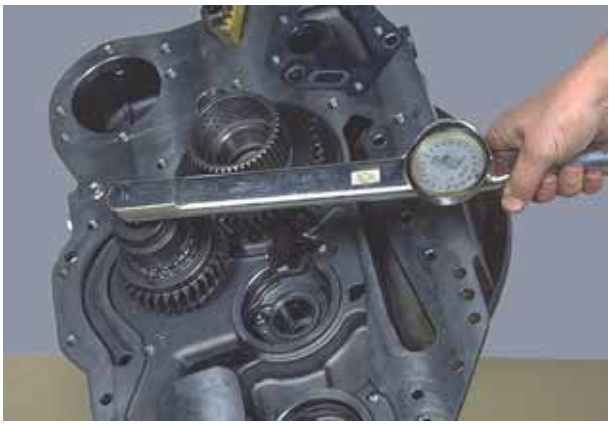


Figure 208
Tighten nut 200 to 250 ft. lbs.
Torque (271.2 – 338.8 Nm.). Use TG 1304-54.

Figure 209

Bend over tag of lock plate that aligns with one of the slots of the lock nut, to secure it (See figure 210).

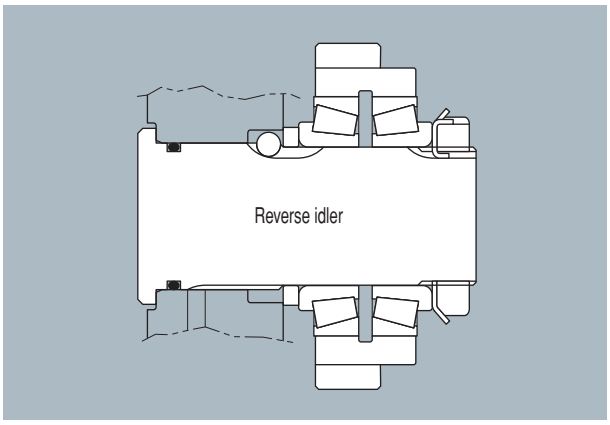


Figure 210

Figure 211

Spread ears on reverse clutch front bearing locating ring. Tap reverse and 2nd clutch assembly into converter housing.Align the snap ring groove in the bearing with the snap ring in the housing, being certain bearing snap ring is in full position in snap ring groove.

Figure 212

Spread ears on 3rd clutch front bearing locating ring. Tap clutch assembly into converter housing. Align the snap ring groove in the front bearing with the snap ring in the housing, being certain bearing snap ring is in full position in snap ring groove.

Figure 213

Position the 2nd speed clutch shaft and 3rd speed clutch pilot bearings on clutch shaft, a light coat of good quality grease will hold bearing in position on shaft.

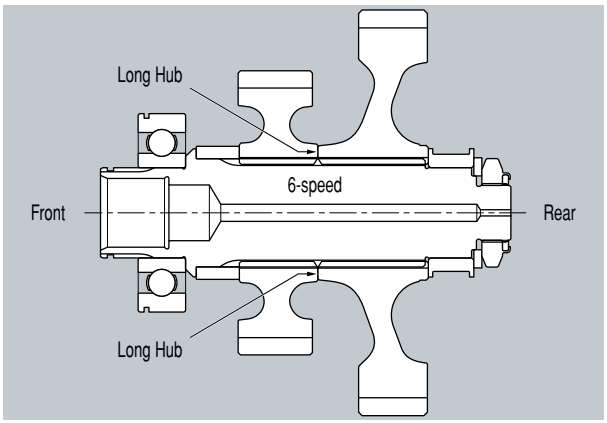


Figure 214

6-Speed cross section. The idler shaft being disassembled is a 6-speed (see figure above). For 3-speed cross section see figure 215.

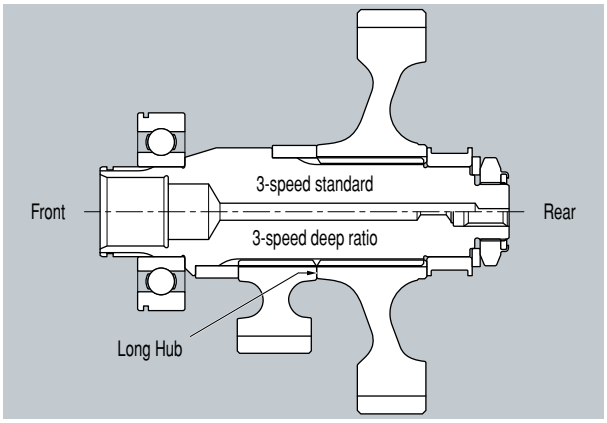


Figure 215

3-Speed cross section.

Figure 216

Remove idler shaft nut.

Figure 217

Remove idler shaft, rear bearing inner race spacer.

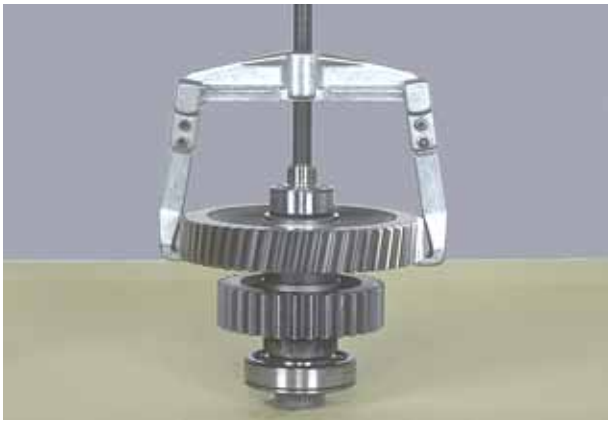


Figure 218

Remove idler shaft gear (rear) and rear bearing inner race.

Figure 219

Remove idler shaft gear (front).

Figure 220
Remove idler shaft gear spacer.

Figure 221
Remove idler shaft front bearing.

Figure 222

Refer to the “Cleaning and Inspection” pages. Install idler shaft front bearing.
NOTE: snap ring groove in front bearing must be up.

Figure 223

Install idler shaft gear spacer.

Figure 224

Install idler shaft gear (front) with long hub of gear up !

Figure 225

Install idler shaft gear (rear) with long hub of gear down.

Figure 226

Install idler shaft rear bearing inner race.

Figure 227

Position bearing inner race washer and retainer nut.

Figure 228

Tighten retainer nut to 200 – 250 lbs.ft. torque. (271.2 – 338.8 Nm.).

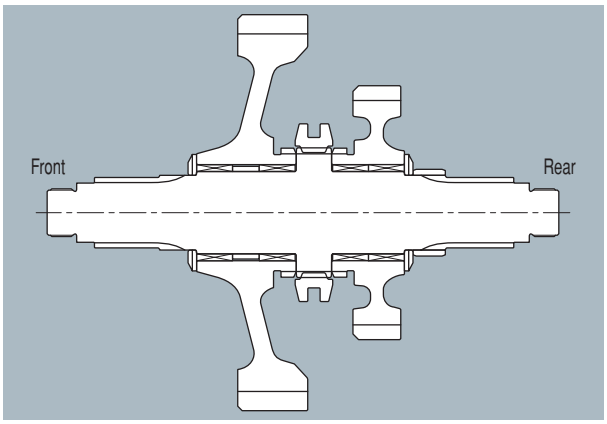


Figure 229
6-Speed cross section. The output shaft being disassembled is a 6-speed (see figure above). For a 3-speed cross section see figure 230.

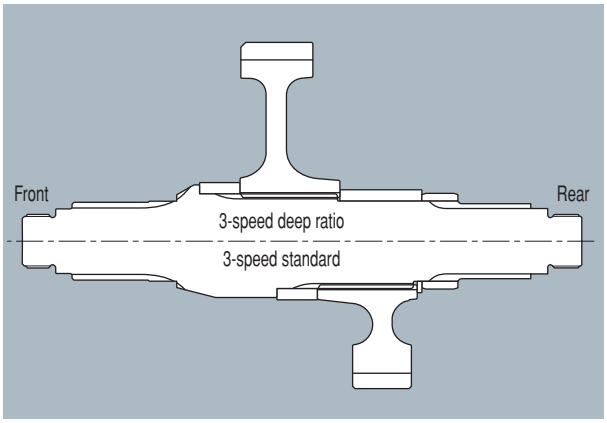


Figure 230
3-Speed cross section

Figure 231
Remove low range gear thrust washer.

Figure 232
Remove low range gear.

Figure 233
Remove low range gear bearings and spacer.

Figure 234
Remove range shaft hub.

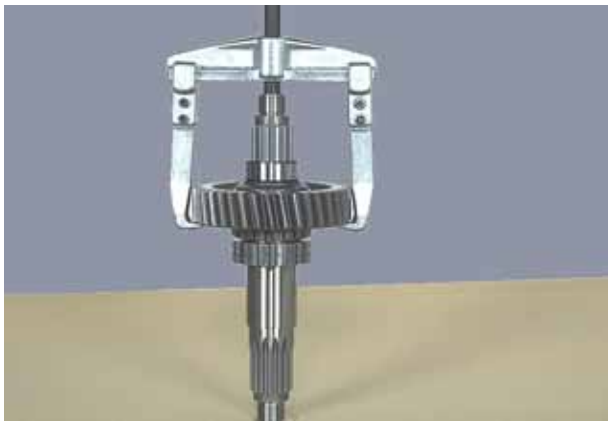


Figure 235

Remove high range gear, gear thrust and rear bearing inner race.

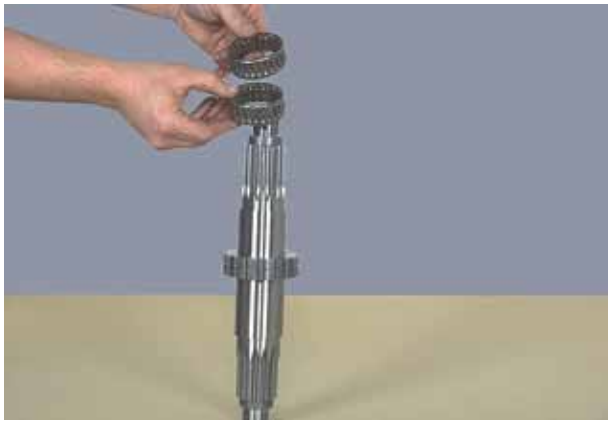


Figure 236

Remove high range gear bearings.

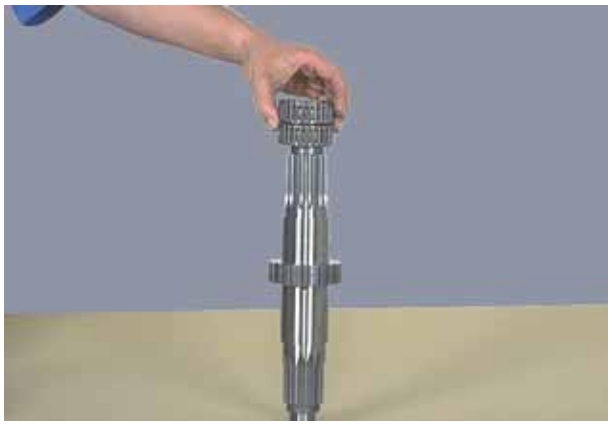


Figure 237

Refer to the “Cleaning and Inspection” pages. Install high range gear bearings.

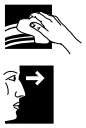


Figure 238

Install high range gear.

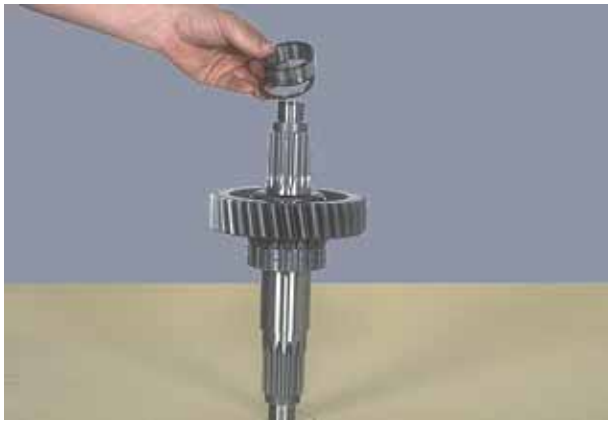


Figure 239

Install high range gear thrust washer and rear bearing inner race.

Figure 240

Install range shift hub.

Figure 241

Install low range gear bearings and spacer.

Figure 242

Install low range gear.

Figure 243
Install low range gear thrust washer.

Figure 244

Refer to the “Cleaning and Inspection” pages. Install forward clutch shaft rear bearing retaining ring.

Figure 245

Position forward assembly into transmission bearing bore.

Figure 246

Spread rear bearing retaining ring. Align snap ring grove with snap ring, release snap ring in groove being sure snap ring is in full position in ring groove.

Figure 247

Install low clutch shaft and idler shaft front bearing retaining ring.

Figure 248

From the front install new output shaft seal with lip of seal towards bearing side. From the rear install output shaft front bearing and outer retaining ring.

Figure 249

Install front bearing inner retaining ring.

Figure 250
Install output shaft assembly.

Figure 253
Install low clutch shaft rear bearing.

Figure 251
Install shaft fork and rod as an assembly on shift hub.

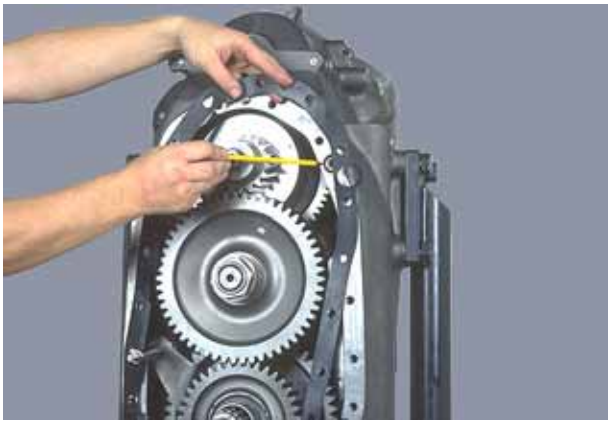


Figure 254
Position new gasket and “O”-ring on rear of transmission housing. A thin coat of chassis grease will hold the gasket and “O”-ring in place.

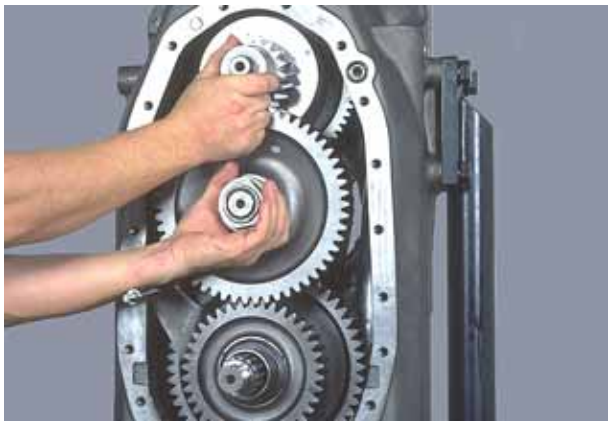


Figure 252
The low clutch (1st) and the idler shaft must be installed in the transmission case together. The help of an assistant or by replacing the transmission case on the front face may facilitate this step. Spread ears on low and idler shaft front bearing retaining ring. From the rear, tap low and idler shaft into position being sure snap rings are in full position in ring grooves.

Figure 255
Install rear cover and bearing outer races as an assembly.
NOTE: two aligning studs facilitate cover to housing assembly. Tap cover bores in place aligning shaft bearings with bearing bores. Use caution as not to damage low clutch shaft sealing ring.
Remove aligning studs and install cover bolts and lockwashers.

Figure 256

Tighten rear cover screws to specified torque (see torque chart).

Figure 259

Press new seal in bearing cap with lip of seal toward bearing side of bearing cap. Position new gasket on bearing cap.

NOTE: some units will have “O”-rings between the cap and the cover.

Figure 257

Install pump hole cover, gasket, screws and lockwasher.

Figure 260

Install lockwashers and stud nuts.
Tighten nuts to specified torque (see torque chart).

Figure 258

Tighten screws to specified torque (see torque chart).

Figure 261

Install output flange, “O”-ring, washer and nut.

Figure 262

Block flange to prevent turning. Tighten flange nut 200- 250 lbs. ft. (271.2 – 339.0 Nm.).
Before installing shaft cylinder assembly replace all "O"-rings and sealing rings (see figure 263 and 264).

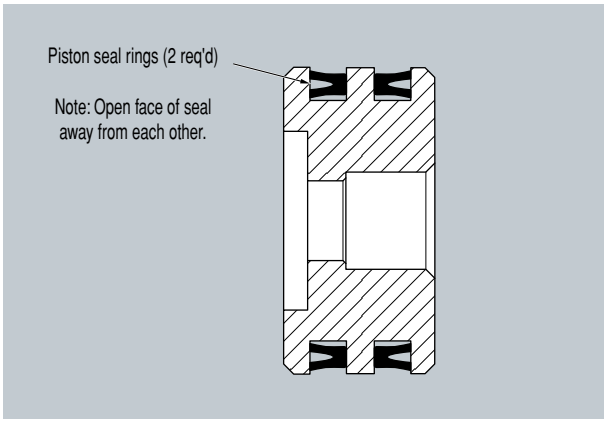


Figure 263

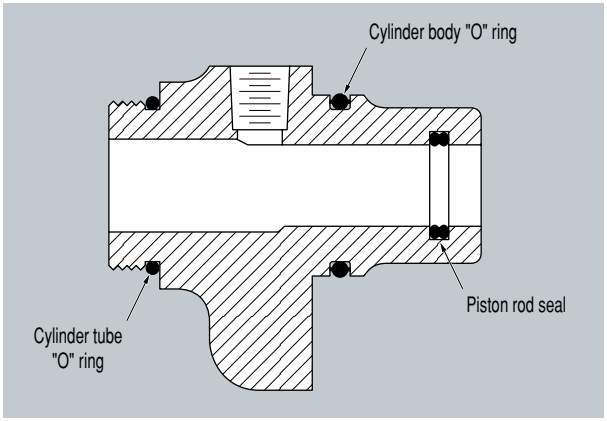


Figure 264

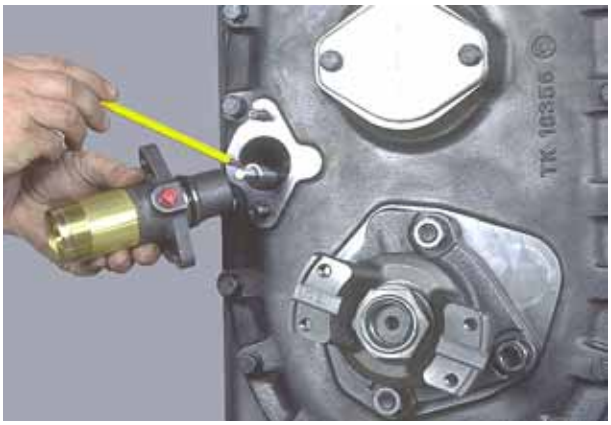


Figure 265

Install new piston rod "O"-ring, position shift cylinder assembly on piston rod.
Use caution as not to damage piston rod sealing ring.

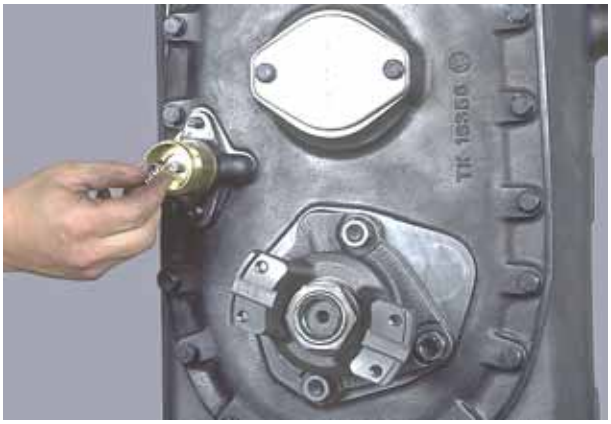


Figure 266

Install piston retaining lock nut.

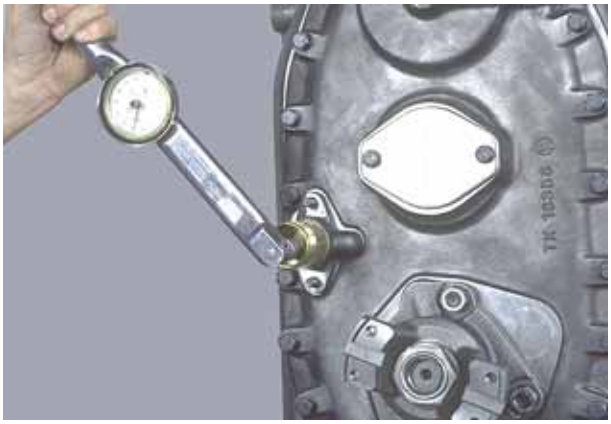


Figure 267

Tighten lock nut to 26 – 29 lbs. ft. (35 – 39 Nm.).

Figure 268

Position new cylinder end cap “O”-ring into end cap.

Figure 271

Install forward clutch pilot bearing.

Figure 269

Install cap and “O”-ring on cylinder tube. Tighten cap securely.

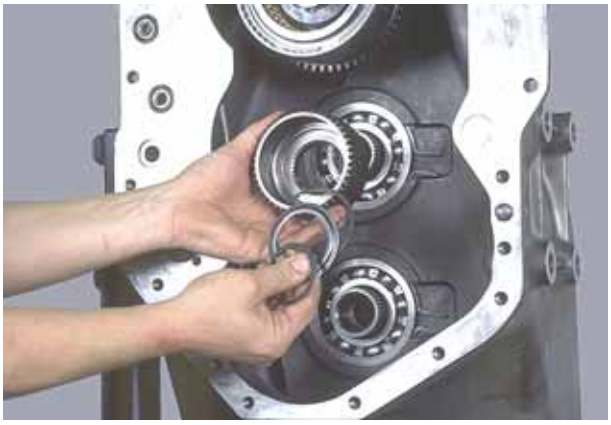


Figure 272

Install 2nd disc hub, hub retaining ring, retaining ring retainer and retainer locating ring. See figure 273.

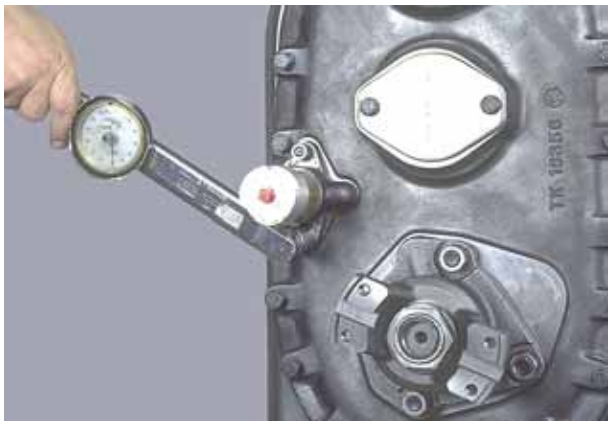


Figure 270

Install cylinder body lockwashers and stud nuts. Tighten nut 37 – 41 ft. lbs. torque (50.2 – 55.5 Nm.).

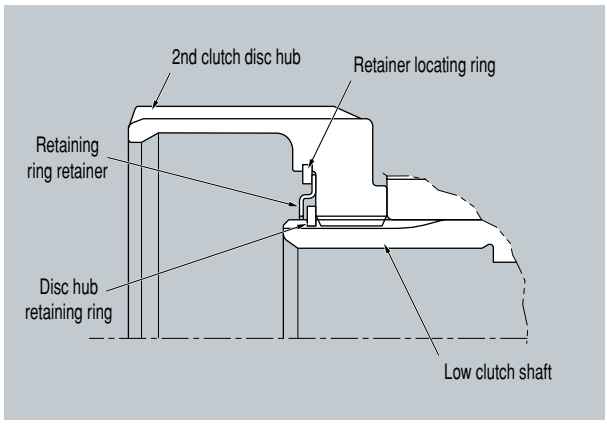


Figure 273

Figure 274

Install 3rd clutch disc hub and retaining ring.

Figure 277

Position new “O”-ring and gasket on front of transmission housing. A light coat of chassis grease will hold “O”-ring and gasket in place.

Figure 275

Install front output flange , “O”-ring, washer and flange nut.

Figure 278

The use of two aligning studs will facilitate aligning the converter housing to the transmission housing. Install converter housing assembly to transmission assembly using extreme caution as to align the clutch pilots to clutch disc hubs. As the clutch pilots enter the disc hubs, turn the turbine shaft and output shaft back and forth. This will help align all of the clutch inner discs with the disc hubs. DO NOT FORCE THIS OPERATION. When all clutches are properly aligned, the converter housing will be tight against the transmission housing. Install two housing to housing capscrews and lockwashers. Remove aligning studs. Install remaining capscrews and lockwashers.

Figure 276

Block flange to prevent turning. Tighten flange nut 200 – 250 lbs. ft. (371.2 – 339.0 Nm.).

Figure 279

Tighten cap screws to specified torque (see torque chart).

Figure 280

Position auxiliary pump drive gear in converter housing. See figure 281.

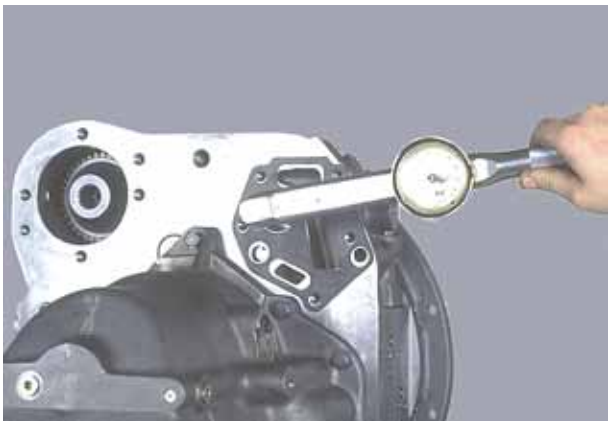


Figure 283

Position charging pump drive gear (see figure 284) and install cap screw with Loctite No. 243. Tighten cap screw to specified torque (see toque chart).

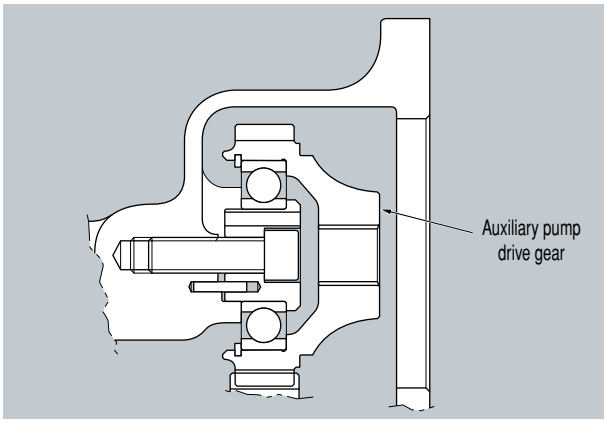


Figure 281

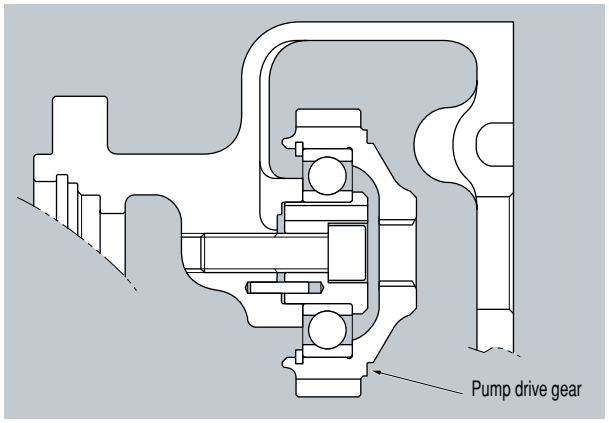


Figure 284

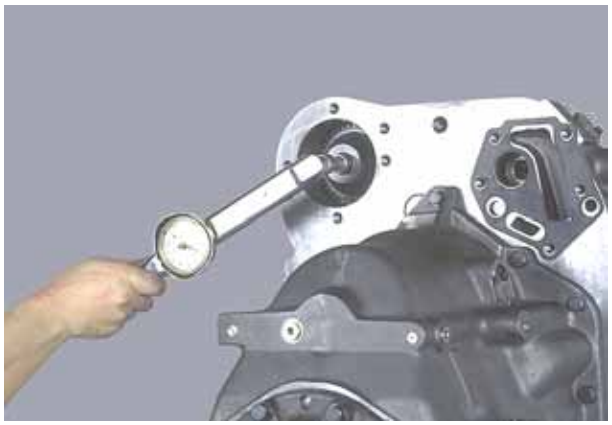


Figure 282

Install cap screw with Loctite No. 243. Tighten cap screw to specified torque (see torque chart).

Figure 285

Using a new gasket and “O”-ring, position charging pump assembly. Install cap screws and lockwashers.
Tighten screws to specified torque (see toque chart).

Figure 286

Install cap screws and lockwashers:
tighten screws to specified torque (see torque chart).

Figure 289

Install idler gear bearing retaining ring.

Figure 287

Install new oil filter. Tighten 20 to 25 ft. lbs torque (27.1 - 33.9 N.m.). **NOTE**: it is recommended that the filter cartridge be changed after 100 hours of operation on new and rebuilt or repaired units.

Figure 290

Position pump idler gear and bearing in stab shaft.

Figure 288

Install pump hole cover, news gasket, screws and lockwashers. Tighten screws to specified torque (see torque chart).

Figure 291

Install idler gear bearing locating ring.

Figure 292

Press new seal in baffle with lip of seal toward impeller hub bearing.
Position new oil baffle sealing ring on oil baffle.

Figure 295

Position converter assembly on stator support and turbine shaft.
NOTE: use extreme caution as not to cut, break or unhook the oil sealing ring in the support.

Figure 293

Position oil baffle in housing and install retaining ring. Be sure ring is in full position in ring groove.

Figure 296

Install converter assembly retaining ring.

Figure 294

Position inner turbine locating ring on turbine shaft.

Figure 297

With new “O”-ring in place, install bore plug.

Figure 298
Install bore plug retaining ring.

Figure 301
Position control valve assembly on aligning studs.

Figure 299
See special section on page 5-1 for drive plate installation.

Figure 302
Install control valve to converter housing screws and lockwashers, tighten screws to specified toque (see torque chart).

Figure 300
To install control valve assembly it is recommended two aligning studs be used to position new control valve gasket.

Figure 303
Install protection cover, screws and lockwashers. Tighten screws to specified torque (see torque chart).

Note:

CLUTCH RETURN DISC SPRING PACKS ARE CERTIFIED ACCORDING TO COMPRESSION WEIGHT SPECIFICATIONS AND ARE PRE-PACKED IN QUANTITIES TO REPAIR ONE (1) SPECIFIC CLUTCH.

The disc spring packs are to be used as complete assemblies and care should be taken not to intermix the individual disc springs with disc springs in another clutch or disc spring pack.

Each disc spring assembly is made up of selected springs to precisely match each part within this assembly. Failure to replace all piston return springs can result in unequal deflection within the spring pack. The result of this imbalance may adversely affect overall life of springs.

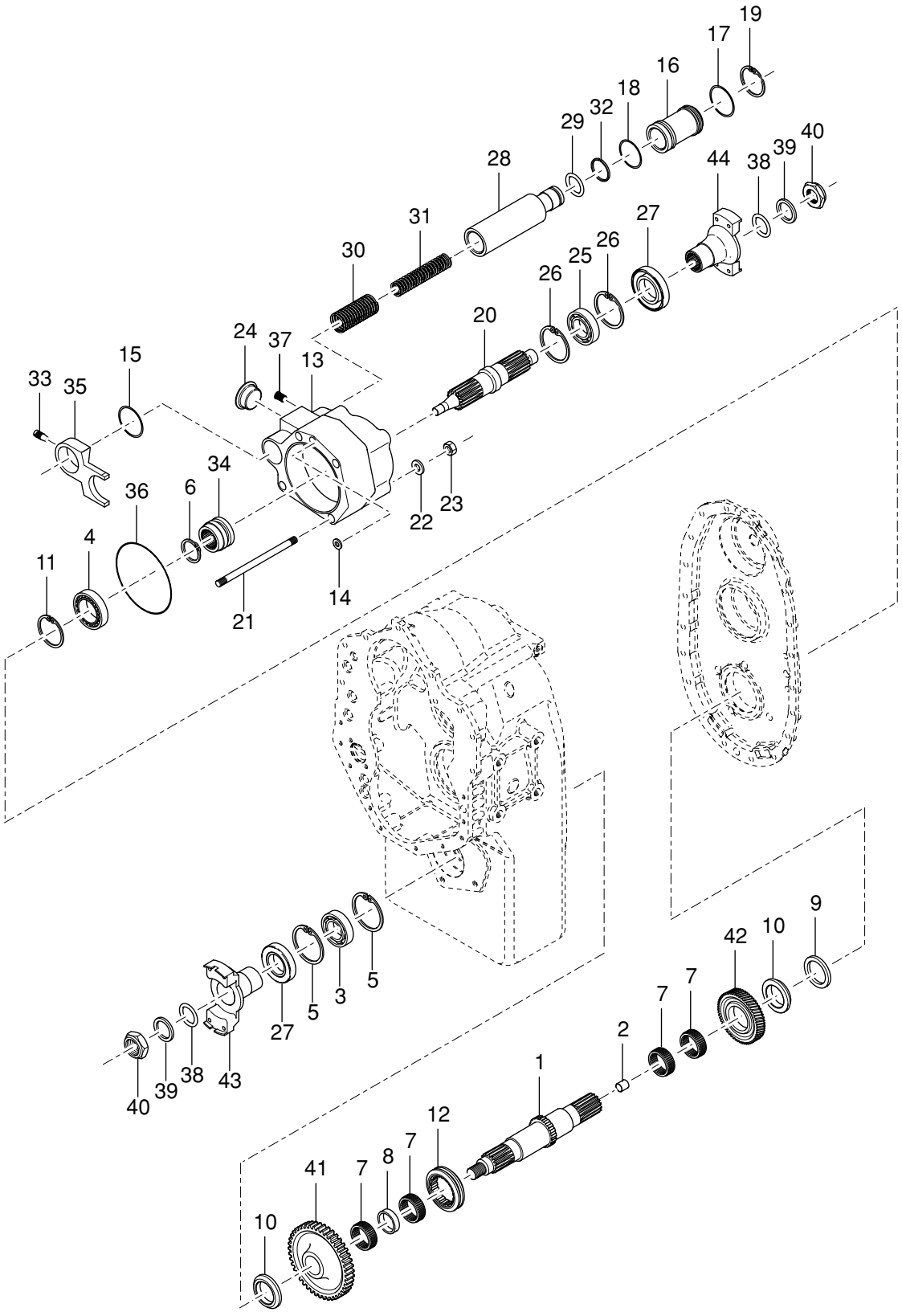
11. OPTIONS

11.1 HYDRAULIC ACTUATED AXLE DISCONNECT

The information contained herein must be used in conjunction with a T20000 LD section.

11.1.1 Sectional views and parts identification

Refer to following pages.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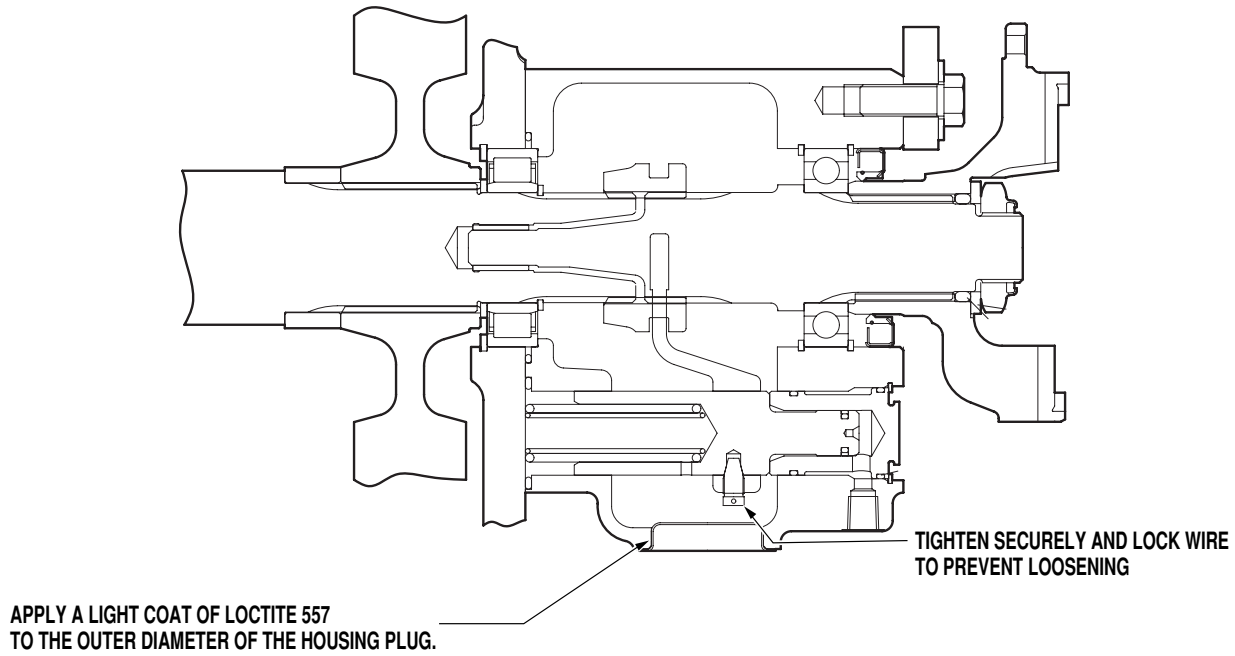
GROUP - HYDRAULIC ACTUATED AXLE DISCONNECT

Item	Description	Quantity
1	Shaft - Output	1
2	Bushing	1
3	Bearing - Output shaft front	1
4	Bearing - Output shaft rear	1
5	Snap ring - Front bearing retaining	2
6	Ring - Output shaft rear bearing retaining	1
7	Bearing - Hi Low gear	4
8	Spacer - Bearing	1
9	Spacer - Bearing	1
10	Washer - Gear thrust	2
11	Ring - Output shaft rear retaining	1
12	Hub - Range shift	1
13	Housing - Diconnect	1
14	“O”-ring - Diconnect housing	1
15	“O”-ring - Diconnect housing	1
16	Plug - Diconnect housing	1
17	“O”-ring - Bore plug	1
18	“O”-ring - Bore plug	1
19	Ring - Bore plug retaining	1
20	Shaft - Diconnect	1
21	Stud - Disconnect housing cap	4
22	Lockwasher - Disconnect housing stud	4
23	Nut - Disconnect housing stud	4
24	Plug - Disconnect housing	1
25	Bearing	1
26	Ring - Bearing retaining	2
27	Seal - Output shaft	2
28	Piston - Hydraulic actuator	1
29	“O”-ring - Piston	1
30	Spring - Air/hydraulic actuator piston - outer	1
31	Spring - Air/hydraulic actuator piston - inner	1
32	Ring - Piston seal glyd	1
33	Lockscrew - Shift fork	1
34	Hub - Shift	1
35	Fork	1
36	“O”-ring - Disconnect housing	1
37	Plug - Shipping	1
38	“O”-ring - Output flange	2
39	Washer - Output flange	2
40	Nut - Output flange	2
41	Gear - Low range	1
42	Gear - High range	1
43	Flange - Output (front)	1
44	Flange - Output (rear)	1

11.1.2 Assembly instructions


TIGHTEN SECURELY AND LOCK WIRE
TO PREVENT LOOSENING
APPLY A LIGHT COAT OF LOCTITE 557
TO THE OUTER DIAMETER OF THE HOUSING PLUG.

11.1.3 Disassembly of output shaft with axle disconnect

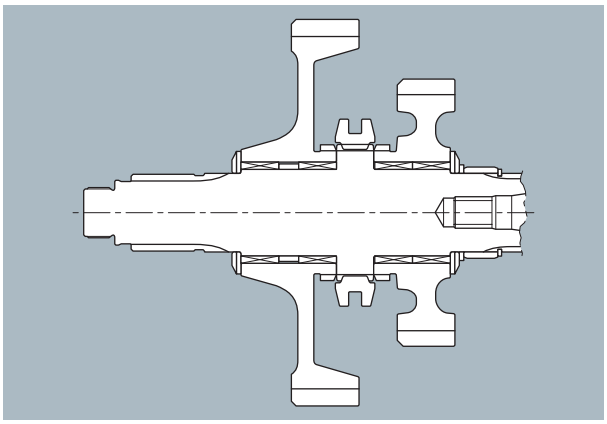


Figure 1
6-Speed cross section with axle disconnect.

Figure 2
Remove low range gear thrust washer.

Figure 3
Remove low range gear.

Figure 4
Remove low range gear bearings and spacer.

Figure 5
Remove range shift hub.

Figure 6
Remove bearing inner race retaining ring.

Figure 7

Remove high range gear, gear thrust washer, bearing spacer and bearing inner race.

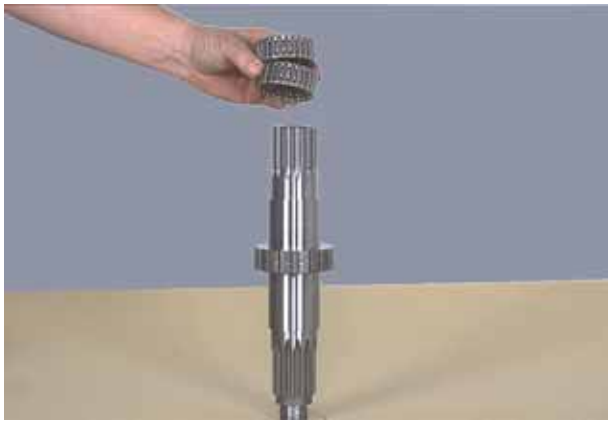


Figure 8

Remove high range gear bearings.

11.1.4 Reassembly of output shaft with axle disconnect

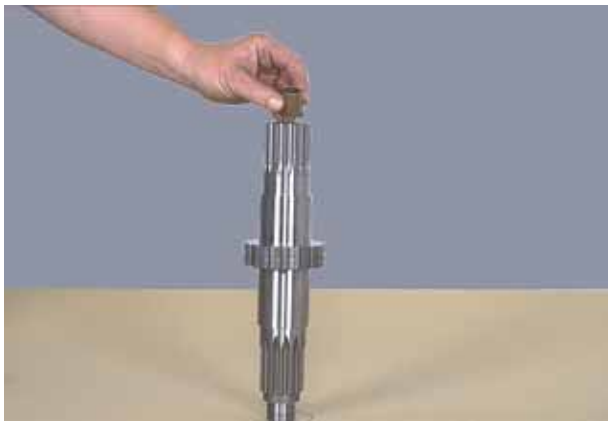
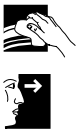


Figure 9

Refer to the “Cleaning and inspection” pages. If bushing worn out, install new bushing.



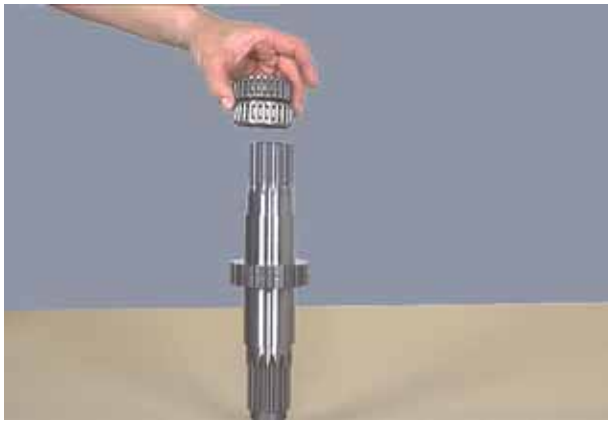


Figure 10

Install high range gear bearings.

Figure 11

Install high range gear.

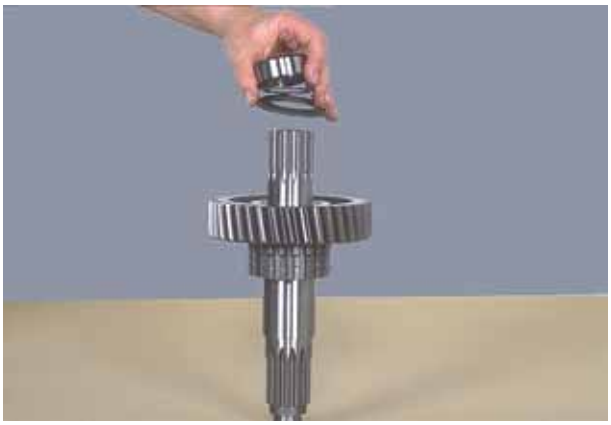


Figure 12

Install, high range gear thrust washer, bearing spacer and bearing inner race.

Figure 13

Install rear bearing inner race retaining ring.

Figure 14

Install range shift hub.

Figure 15
Install low range gear bearings and spacer.

Figure 16
Install low range gear.

Figure 17
Install low range gear thrust washer.

11.1.5 Disassembly of axle disconnect

Figure 18
Remove the inner and outer actuator piston springs.

Figure 21
Remove piston bore plug retainer ring.

Figure 19
The output oil seal must be destroyed by using a punch to drive through the oil seal housing and picking the oil seal out of the disconnect housing.

Figure 22
Remove disconnect shaft outer bearing retainer ring.

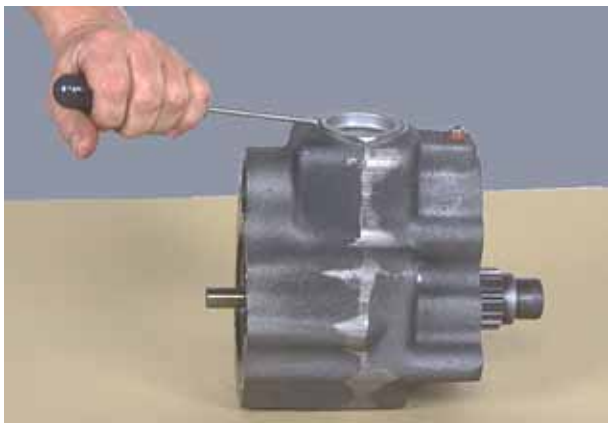


Figure 20
Remove disconnect housing plug.

Figure 23
Remove the shift fork lock screw.

Figure 24
Remove disconnect housing plug.

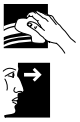
Figure 27
Shift and shift fork removed.

Figure 25
Remove actuator piston.

Figure 26
Tap disconnect shaft and bearing from housing.

11.1.6 Reassembly of axle disconnect

Figure 28



Refer to the “Cleaning and inspection” pages.
Position shift fork on shift hub. Insert actuator into disconnect housing.
Hold shift hub and fork in housing, align shift fork and actuator piston. Insert piston in shift fork.

Figure 29

Install “O”-ring and glyd ring on actuator piston (see figure 29).

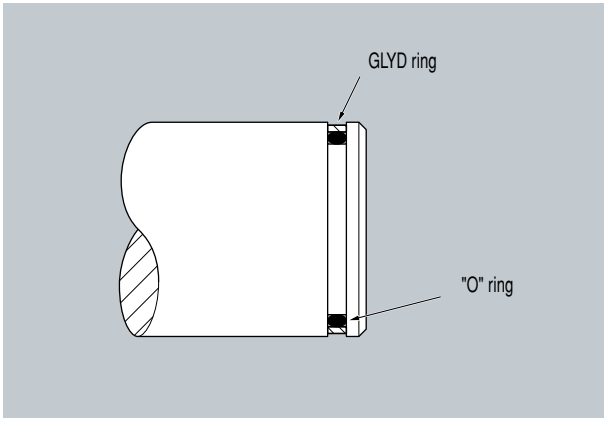


Figure 30

Figure 31

Align hole in actuator piston with hole in shift fork.
Install shift fork lock screw.
Tighten securely and lock wire to prevent loosening.

Figure 32

Align splines on disconnect shaft with splines in shift hub.

Figure 33

Tap shaft and bearing in place.

Figure 34
Install shaft bearing outer retainer ring.

Figure 37
Secure bore plug with retaining ring.

Figure 35
Press seal in disconnect housing with lip of seal in.

Figure 38
Apply a light coat of Loctite 577 to the outer diameter of the housing plug.
Tap plug into position in housing.

Figure 36
Position two new “O”-rings on piston bore plug.
Align hole in plug with hole in housing. Install plug.

Figure 39
Install disconnect housing “O”-rings in housing.

Figure 40

Insert the actuator piston inner and outer return springs in piston.

Figure 43

Install output flange “O”-ring, washer and flange nut.

Figure 41

Use new “O”-rings on assembly. Position disconnect assembly on disconnect mounting studs. Install stud nuts and lockwashers.

Figure 44

Block flange to prevent turning. Tighten flange nut to specified torque (see elastic stop nut chart).

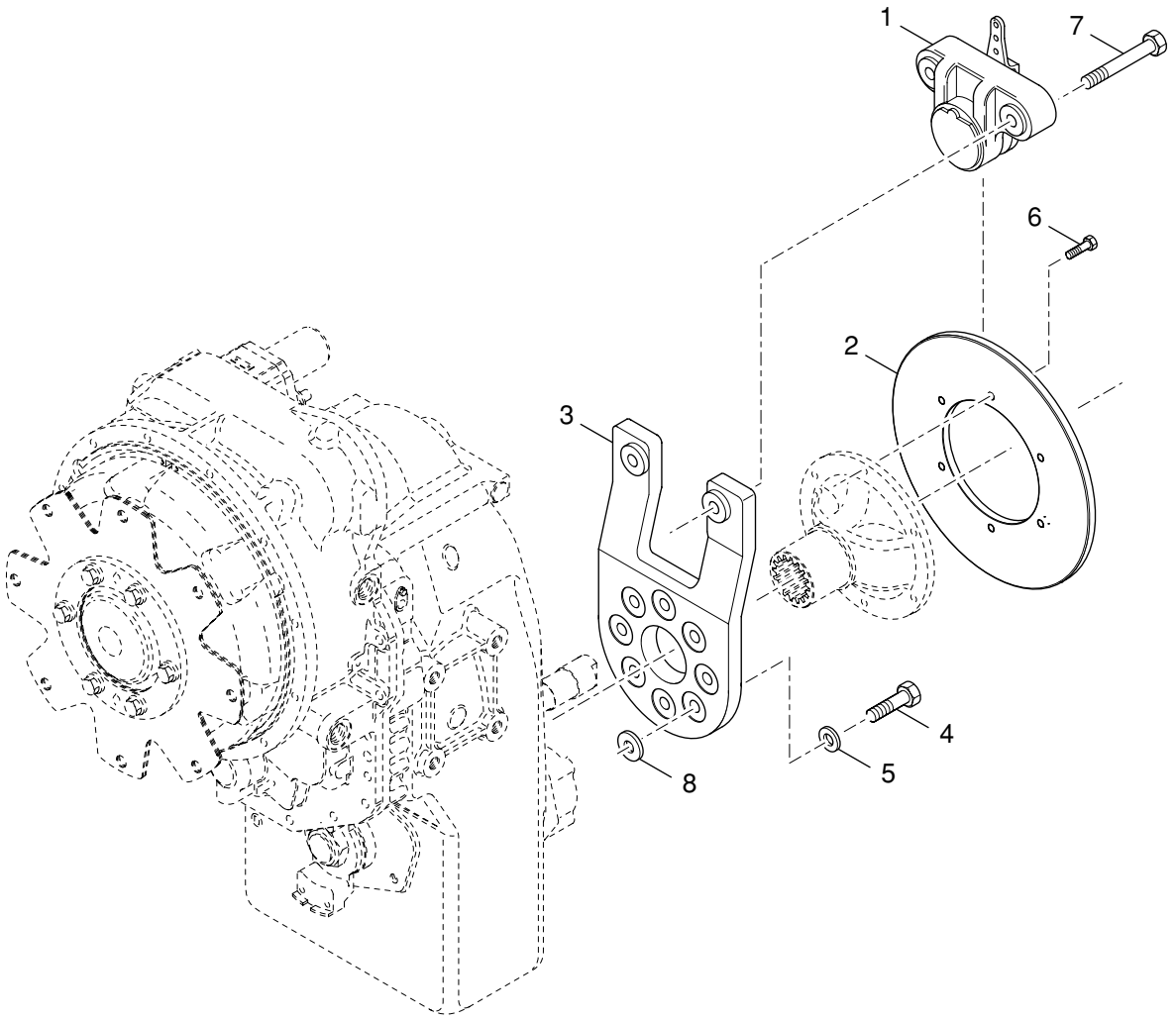
Figure 42

The actuator piston springs must be compressed against the rear cover to start the stud nuts and lockwasher. Tighten stud nuts to specified torque (see torque chart).

11.2 PARKING BRAKES

11.2.1 Mechanical Brake

11.2.1.1 Sectional views and parts identification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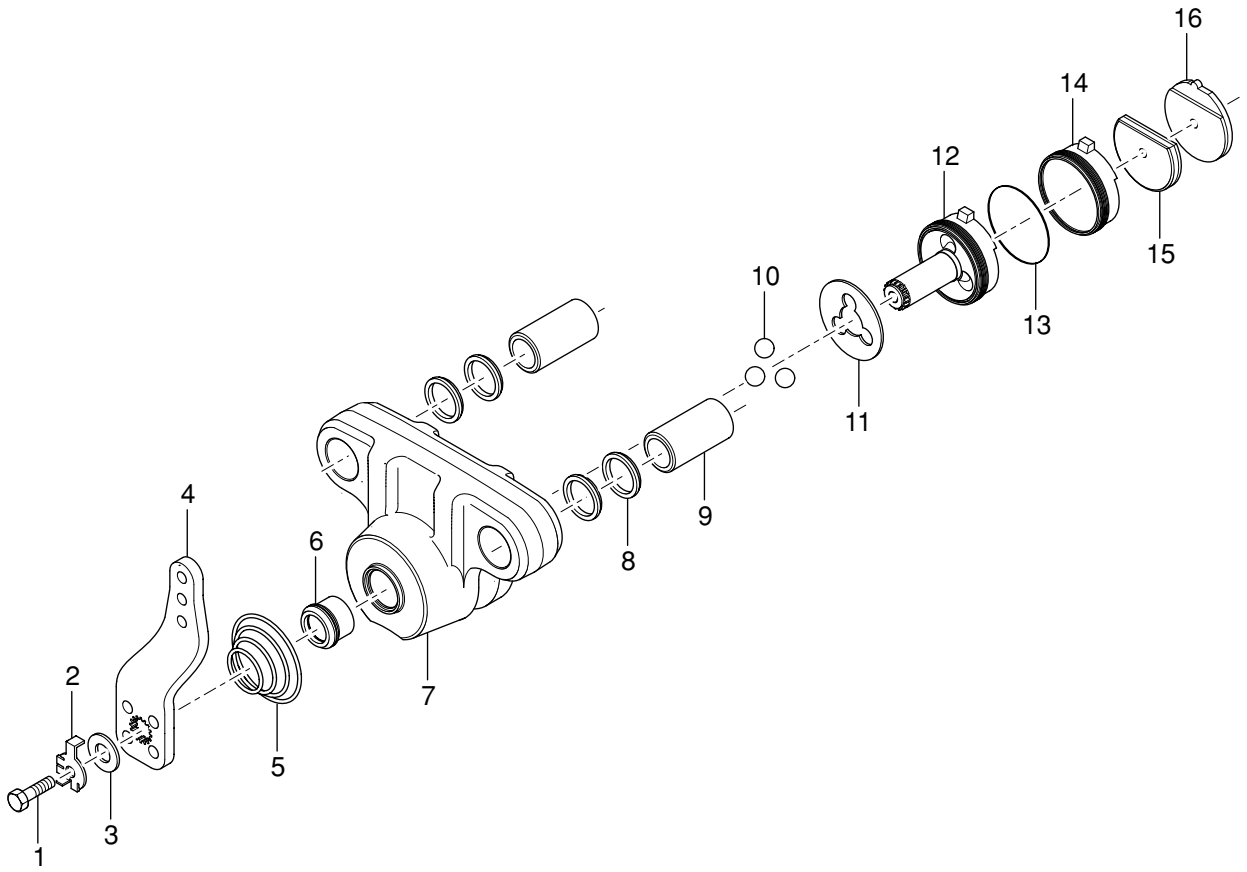
GROUP - DISC BRAKE (MECHANICAL BRAKE)

Item	Description	Quantity
1	Caliper - Parking brake	1
2	Disc - Brake	1
3	Assembly - Mounting bracket	1
4	Screw - Bracket assembly to brg cap mtg	4
5	Washer - Bracket assembly to brg cap mtg flat screw	4
6	Screw - Flange	6
7	Screw - Caliper to mounting bracket	2
8	Spacer	2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GROUP - MECHANICAL BRAKE

Item	Description	Quantity
1	Screw	1
2	Anti-rotation clip	1
3	Washer	1
4	Lever	1
5	Spring	1
6	Shaft - Seal	1
7	Housing	1
8	“O”-ring	4
9	Bushing	2
10	Ball	3
11	Ball - Spacer	1
12	Rotor	1
13	Plain bearing	1
14	Rotor - Seal	1
15	Lever side pad	1
16	Carrier side path	1

11.2.1.2 Adjustment and rebuild criteria

1. Check to insure floating parts move freely and that all other parts are mounted securely. Tighten hardware as required.
2. Check actuator linkage to insure that there is adequate freedom of movement for positive brake operation. Adjustment of pad gap is to be accomplished by adjusting the actuating cable or linkage. If adjustment is used up, back off cable or linkage. Unbend tab on anti-rotation clip and loosen screw enough to disengage lever spline. Rotate the lever one tooth, in the direction opposite the actuation direction, and retorque the screw making sure the spline teeth are properly engaged. Bend up a tab that aligns with one of the screw head flats, to prevent screw rotation. Both lever and linkage must be free to return to home position. An external return spring is required.
3. Check disc surface condition. Replace if it is badly warped, pitted, or below minimum recommended thickness. Check for loose mount bolts. Retighten if necessary.
4. Check to insure friction pads are not worn to less than .039" (1.0mm) thick. Replace worn friction pads. Generally, if the disc is still running true and the pad clearance is still adjustable, no other maintenance is required. To check for wear, measure the distance from the carrier side casting face to disc face. If the distance is less than .060" (1.5mm), replace the friction pads.

11.2.1.3 Replacing friction pads

Note

Stamped on the back of each friction pad is a code. The first 1 or 2 characters is a number that specifies the friction material type. Check to insure new pads are the same as the worn pads removed. Replace friction pads only in pairs.

To replace the friction pads it is necessary to release the brake and disconnect the actuator from the brake lever.

1. Remove one brake mounting bolt. Swing the brake up over the disc to expose the brake pads. In close clearance applications the brake may be removed from the vehicle. Using a flat bladed screw driver, pry out the used brake pads from their respective positions. The lever side friction pad is snapped onto the plastic actuator cover. Care should be used in removing the friction pad from the plastic actuator cover so as not to break off the center snap tabs.
2. Place the new friction pads in their respective positions. The lever side friction pad has a center hole which snaps over the plastic snap tabs of the actuator cover. The flat on the lever side pad must align with the flat on the plastic rotor cover, allowing the pad to sit flat. If the snap tabs are gone dab some silicone gasket adhesive around the back edge of the friction pad and press firmly into place aligned as described above. Before placing the carrier pad in postition, clean out excisting pad glue from the pad compartment. Place a layer of silicone gasket adhesive all along the back edge of the carrier friction pad and press firmly in place. Push the lever side pad into the brake as far as possible.
3. Swing the brake over the disc and install the mounting bolt and tighten all mounting bolts.
4. After friction pad replacement, the brake actuating lever is no longer in the correct position for the actuating linkage. Unbend tab on anti-rotation clip and loosen screw enough to disengage the lever spline. Rotate the lever to the OEM and torque screw to 110 - 140 in.lbs.(12.4 -15.8 Nm). Bend up a tab on the antirotation clip that aligns with one of the screw head flats, to prevent screw rotation. Attach actuating cable or linkage to the lever. Adjustment of pad gap is accomplished by adjusting the actuating cable or linkage.

11.2.1.4 Disassembly

Perform disassembly on a clean work bench.

1. Disconnect the actuator cable or linkage and remove brake from its mounting.
2. Remove friction pads. (see “Replacing Friction Pads”)
3. Unbend anti-rotation clip tab away from lever holding screw. Remove screw, anti-rotation clip, washers, lever, and spring.
4. Push out rotor assembly from the casting.

Caution

BALL SPACER AND 3 BALL BEARINGS MAY COME OUT WITH THE ROTOR ASSEMBLY.
(FOR ROTOR DISASSEMBLY SEE “SERVICING ROTOR ASSEMBLY”).

5. Remove 3 ball bearings and ball spacer.
6. Shaft seal need only be replaced if excessively wom or cracked. If replacement is necessary, press out the plastic shaft seal from inside the casting, using a steel spacer block 1.078"(27.38mm) diameter by 2.5” (63.5mm) long and an arbor press.

Note

POPULAR BRAND NAME 3/8" DRIVE 13/16" HEX DEEP SOCKET WORKS WELL AS A SPACER BLOCK.

7. After the shaft seal is pressed out, remove the sliver of plastic that may be left in the groove in the casting.

This completes disassembly of the brake.

11.2.1.5 Cleaning and inspection

1. Clean all parts with denatured alcohol and either wipe dry with a clean lint free cloth or blow dry with an air hose.
2. Examine all parts carefully for signs of excessive wear, damage, or corrosion. Replace any parts found to be damaged.
3. Check rotor assembly for cracks. Replace if necessary.
4. Inspect the casting ball pockets for scoring, pitting, cracks or corrosion. A corroded or deeply scored casting should be replaced. Light scoring and stains may be removed.
5. Check to see that the disc is not bent or misshaped.
6. Check lever spring for breakage.

11.2.1.6 Assembly

Prior to assembly make sure all parts are clean and serviceable.

1. Install a new shaft seal by inserting the seal from the outside of the casting with the extended smooth surface inserted first. Using an arbor press, with a protective spacer block between the arbor press and the seal, gently press the seal in until it snaps into the groove in the casting.
2. Coat with grease, the ball pockets in the casting, the shaft and ball pockets of the rotor assembly.
3. Insert 3 ball bearings and ball spacer into the pockets in the casting.
4. From the inside of the casting slide the shaft of the rotor assembly thru the shaft seal and seat the ball pockets against the ball beanrings.
5. Place the spring over the large diameter pilot on the outside of the casting.
6. Install the lever, making sure the small diameter of the spring is piloted on the outside of the 4 pins in the lever. Set the lever in the OEM position.
7. Install the washers and anti-rotation clip with its tab inserted into the lower hole in the lever.
8. Insert screw into rotor assembly shaft and tighten to 110 - 140 in.lbs.(12.4 - 15.8Nm), while guiding lever over rotor assembly spline.
9. After the proper torque is achieved and the lever is in the OEM position, bend up a tab on the anti-rotation clip that aligns with one of the screw head flats, to prevent screw rotation.
10. Install the friction pads onto the rotor assembly and carrier. (see ‘’Replacing Friction Pads”).
11. Stroke lever in its proper direction. The lever must rotate thru 60 degrees of rotation. Return lever to the OEM position and make sure the lever side friction pad is fully rerurned.

11.2.1.7 Replacing mount bushings

1. Push mount bushings completely out of the brake casting.
2. Remove the four (4) “O”-rings from the grooves in the casting, being carefull not to damage the grooves. Clean the grooves and the bore with denatured alcohol or cleaning solvent. Let dry. Lubricate the grooves and “O”-rings with the grease furnished with the service kit. Install the “O”-rings into the grooves.
3. Coat the bushings with kit grease. Insert bushing through the “O”-ring. Wipe off any excess grease.

11.2.1.8 Servicing rotor assembly

Disassemble brake as previously described.

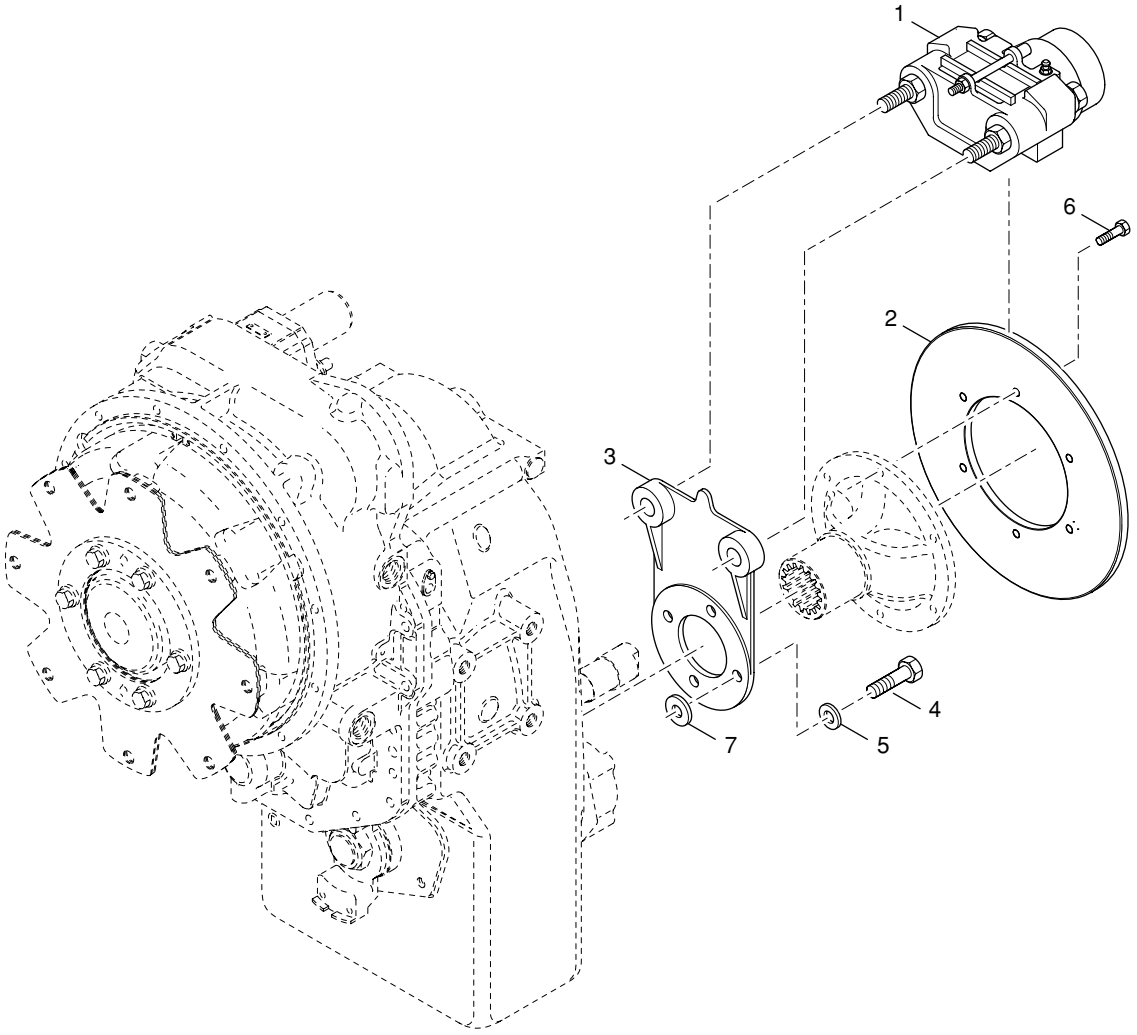
1. Using a sharp knife, make several cuts through the outside diameler of the rigid plastic rotor cover. Break apart the plastic, remove and discard.
2. Discard the plain bearing from under the plasic cover
3. Thoroughly clean all dirt and grease residue from the rotor.
4. Amply grease one face of the new plain bearing and place it into the new rotor cover, grease to plastic. Amply grease the other face of the insert.
5. To assemble the new plastic rotor cover a bench vise is necessary. Snap a friction pad onto the plastic cover. Place the plastic cover over rte rotor, place in a vice, and slowly squeeze the cover and rotor until the cover snaps in place. Remove the friction pad and reassemble the brake as previously described.

11.2.2 Spring applied hydraulic released brake (high pressure)

Note

PLEASE READ INSTRUCTIONS BELOW BEFORE ATTEMPTING ANY WORK ON THE BRAKE.

11.2.2.1 Sectional views and parts identification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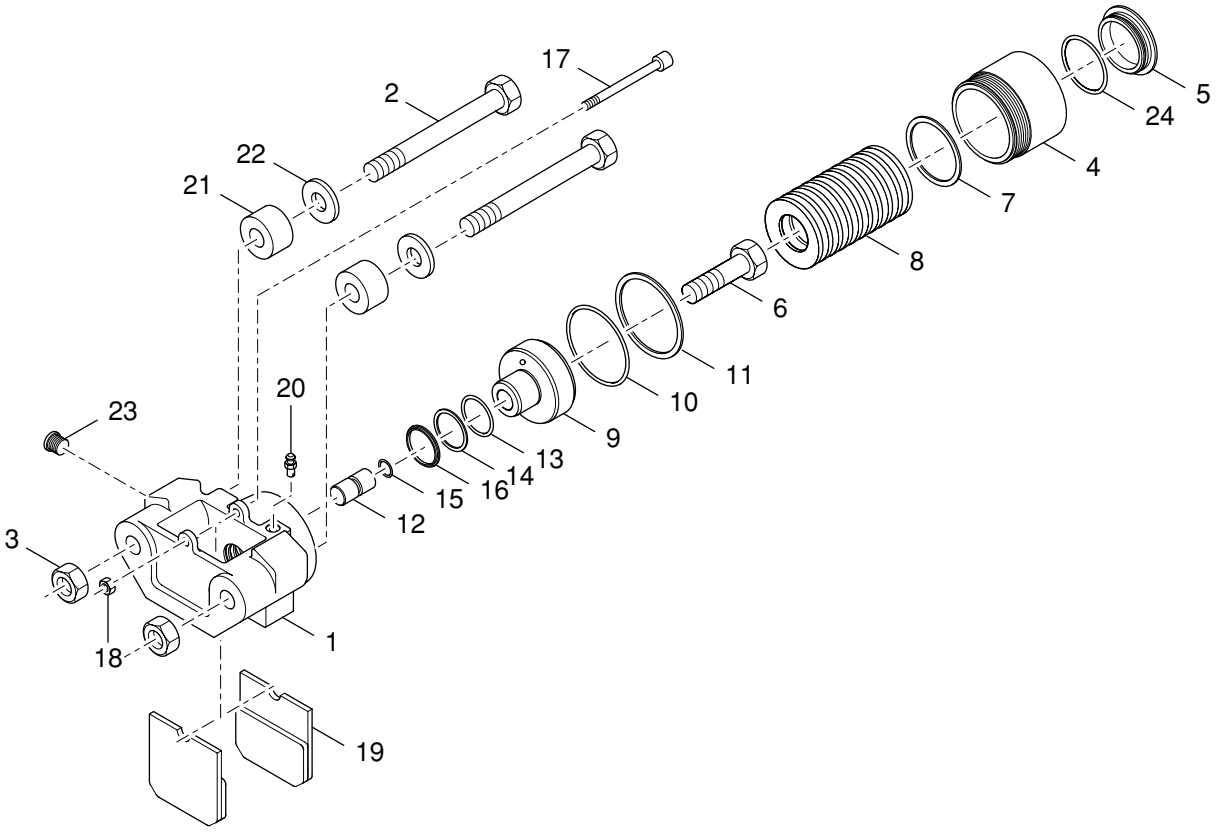
GROUP - DISC BRAKE (SPRING APPLIED HYDRAULIC RELEASED BRAKE (HIGH PRESSURE))

Item	Description	Quantity
1	Caliper - Parking brake	1
2	Disc - Brake	1
3	Assembly - Mounting bracket	1
4	Screw - Bracket assembly to brg cap mtg	4
5	Washer - Bracket assembly to brg cap mtg flat screw	4
6	Screw - Flange	6
7	Spacer	4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SPRING APPLIED HYDRAULIC RELEASED BRAKE (HIGH PRESSURE)

Item	Description	Quantity
1	Torque plate	1
2	Bolt - Hex	2
3	Jamnut	2
4	Housing - Spring	1
5	Plug	1
6	Bolt - Adjustment	1
7	Shim	AR*
8	Spring disc	10
9	Piston	1
10	Seal - “O”-ring	1
11	Back-up ring	1
12	Piston	1
13	Seal - “O”-ring	1
14	Back-up ring	1
15	Seal - “O”-ring	1
16	Wiper	1
17	Bolt	1
18	Nut	1
19	Lining	2
20	Bleeder	1
21	Spring - Urethane	2
22	Washer - Flat	2
23	Cap - Plug	1
24	Seal - “O”-ring	1

AR*: As Required

11.2.2.2 Operation

Ten disc springs (8) are used to hold the park brake in the actuated state.
The springs (8) push the pistons (9,12) into the lining and carrier assembly (19) which squeezes a driveline mounted disc. The brake is released by fluid entering a SAE 7/16-20 threaded inlet in the side of the torque plate (1) which pushes the pistons back and compresses the springs (8).

11.2.2.3 Adjustment and rebuild criteria

1. Apply hydraulic pressure to the brake.
2. Remove plug (5) and set running clearance (.020” - .030”) using the adjustment bolt (6).
3. Replace plug (5).
4. Even up running clearance on each side of the disc by adjusting the carrier retaining bolt (17).

The brake should be rebuilt when one or more of the following criteria are met:

1. Any signs of fluid leakage.
2. Lining thickness less than .031".
3. Cracked or chipped linings.

11.2.2.4 Replacing friction pads

1. Apply hydraulic pressure to the brake and remove plug (5) and carrier bolt (17).
2. With pressure applied, back-off adjustment bolt (6) until piston (12) is flush with piston (9).
3. Release hydraulic pressure from the brake and remove lining and carrier assemblies (19).

11.2.2.5 Disassembly

Caution

IF THE PARK BRAKE IS BEING DISASSEMBLED WHILE ON THE VEHICLE, IT IS IMPORTANT TO FOLLOW THE DIRECTIONS REGARDING THE REMOVAL OF THE SPRING HOUSING (4) AND THE LINING AND CARRIERS (19) VERY CLOSELY.

1. Apply hydraulic pressure to the brake and remove plug (5) and carrier bolt (17).
2. With pressure applied, back-off adjustment bolt (6) until piston (12) is flush with piston (9).
3. Release hydraulic pressure from the brake and remove lining and carrier assemblies (19).
4. Using a press, compress springs (8) to reduce the force on the spring housing (4).
5. Use a spanner wrench to remove the spring housing (4) (counter-clockwise direction).
6. The springs (8) will be accessible when the spring housing is removed.

Note

THE SPRING HOUSING (4) MAY BE REMOVED WITHOUT COMPRESSING THE SPRINGS (8), HOWEVER IT IS NOT RECOMMENDED DUE TO THE HIGH TORQUE REQUIRED.

7. The adjustment bolt (6) threaded part of the way into the hydraulic piston (9) may be used to remove the pistons (9 and12) if brake is mounted on the vehicle.
8. If brake is not mounted to the vehicle it is easier to press the pistons out from the lining and carrier (19) side of the torque Plate (1).

Caution

DO NOT DAMAGE SEALS (10,13,15) OR BACK-UP RINGS (11,14) OR THE WIPER (16) WHEN REMOVING THE PISTONS (9 AND12).

9. Piston (12) may be removed from piston (9) by pushing on piston (12) through adjustment bolt hole with a small nut-river or similar device.

11.2.2.6 Cleaning and inspection

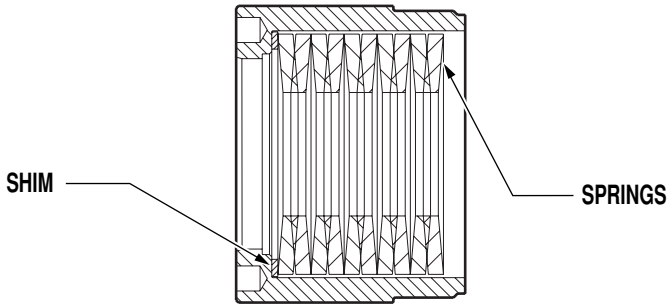
1. Clean all metal parts prior to assembly.
2. Blow excess cleaning solution off of all parts and out of all fluid passages.

11.2.2.7 Assembly

1. Apply a thin coat off fluid (compatible with mineral oil based hydraulic fluid) to seals (10,13,15), Back-up rings (11,14) and the wiper (16).
2. Install seal (15) in seal groove on piston (12).
3. Slide the adjustment piston (12) into the bore located in the hydraulic piston (9) until it hits the bottom of the bore.
4. Install wiper (16), back-up ring (14), and seal (13) in the grooves located in the small hole in the torque plate (1).
5. Install seal (10) and back-up ring (11) in larger grooves in torque plate (1).
6. Install piston assembly into torque plate. (1).
7. Thread adjustment bolt (6) into the hydraulic piston (9) until the bolt contacts the adjustment piston (12).
8. Place springs (8) in the torque plate (1).
   Springs should be placed in an alternating cupped face to cupped face orientation.
   The springs on the outside ends of the stack should be oriented cupped face out.
9. If the brake contained a shim (7) when it was disassembled, place the shim (7) so it will be in the bottom of the spring housing (4) when it is installed. See illustration below for a graphical representation.

Note

SPRINGS ARE MATCHED AND PRETESTED. IF NEW SPRINGS ARE BEING INSTALLED ADD A SHIM ONLY IF THE NEW SPRINGS ARE SHIPPED WITH ONE.



10. Thread spring housing (4) into torque plate (1) about 3 turns or until it makes contact, with the springs (8).
11. Using a press, compress springs (8) to reduce the force on the spring housing (4).
12. Use a spanner wrench to tighten spring-housing until the face bottoms out on the counterbore face in the torque plate (1). Tighten to 500 - 600 lb.-in torque.
13. Assemble washer (22) and the urethane spring (21) on the mounting bolt (2) then slide mounting bolts through bolt holes in the torque Plate (1).
14. Thread jam nut/sleeve (3) onto mounting bolt.
    The cylindrical part of the jam nut/sleeve should extend into the torque plate.

15. Install lining and carrier assemblies (19).
    Thread lining and carrier adjustment bolt into hex nut (8) located in the slot in the back side of the torque plate (1).
16. Install the bleeder (20) in the port located on the top side of the torque plate (1).
17. After brake is mounted and adjusted, snap plug (5) onto spring housing (4).

11.2.2.8 Installation

1. Slide brake over disc and into the mounting position.
2. Start mounting bolts (2) into mounting surface far enough to just support the brake.
3. Remove plug (5) and tighten adjustment bolt (6) until linings (19) are clamped to the disc.
4. Tighten mounting bolts (2) until they make contact with the urethane springs (21), then tighten 1 to 2 flats more.
5. Tighten jam nut/sleeve (3) against mounting surface to torque shown in section 11.2.2.9.

Caution

BRAKE LININGS ARE SUSCEPTIBLE TO CONTAMINATION.
WHEN INSTALLING OR SERVICING BRAKES KEEP ALL OIL AND FLUIDS AWAY FROM THE LININGS.
POOR BRAKE PERFORMANCE MAY RESULT.

6. Attach brake line to inlet port located on the side of the torque plate (1).
7. Bleed brake system to remove trapped air as follows.

Note

USE BLEEDER HOSE ON BLEEDER SCREWS (PREFERABLY CLEAR TUBING) TO ROUTE FLUID AWAY FROM THE BRAKE AND LININGS.

Caution

BRAKE USES HIGH PRESSURE, OPEN BLEEDER SCREW (20) VERY SLOWLY WHEN PERFORMING BLEEDING PROCEDURE.

8. Apply pressure to brake and slowly open the bleeder screw (20) observe any air bubbles that flow from the brake.
9. Repeat above paragraph until no air is observed in the fluid from the bleeder screw (20).

11.2.2.9 Torque specs

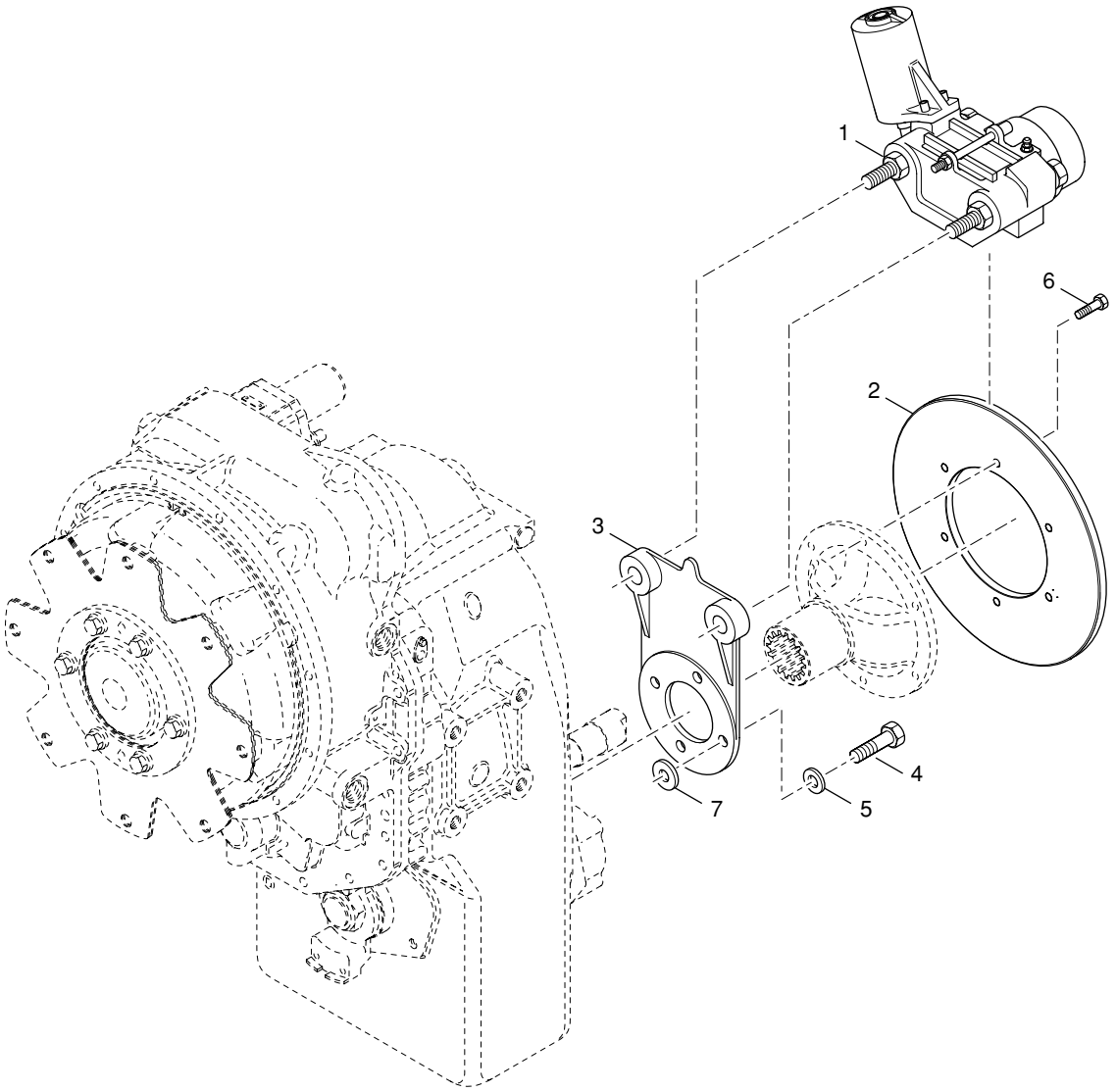
PART (ITEM NO.)	THREAD SIZE	DRY TORQUE
BLEEDER SCREW (20)	7/16 - 20	200 - 250 (LB-IN)
JAMNUT/SLEEVE (3)	3/4 - 10	200 (LB-IN)

11.2.3 Spring applied hydraulic released brake (low pressure)

Note

PLEASE READ INSTRUCTIONS BELOW BEFORE ATTEMPTING ANY WORK ON THE BRAKE.

11.2.3.1 Sectional views and parts identification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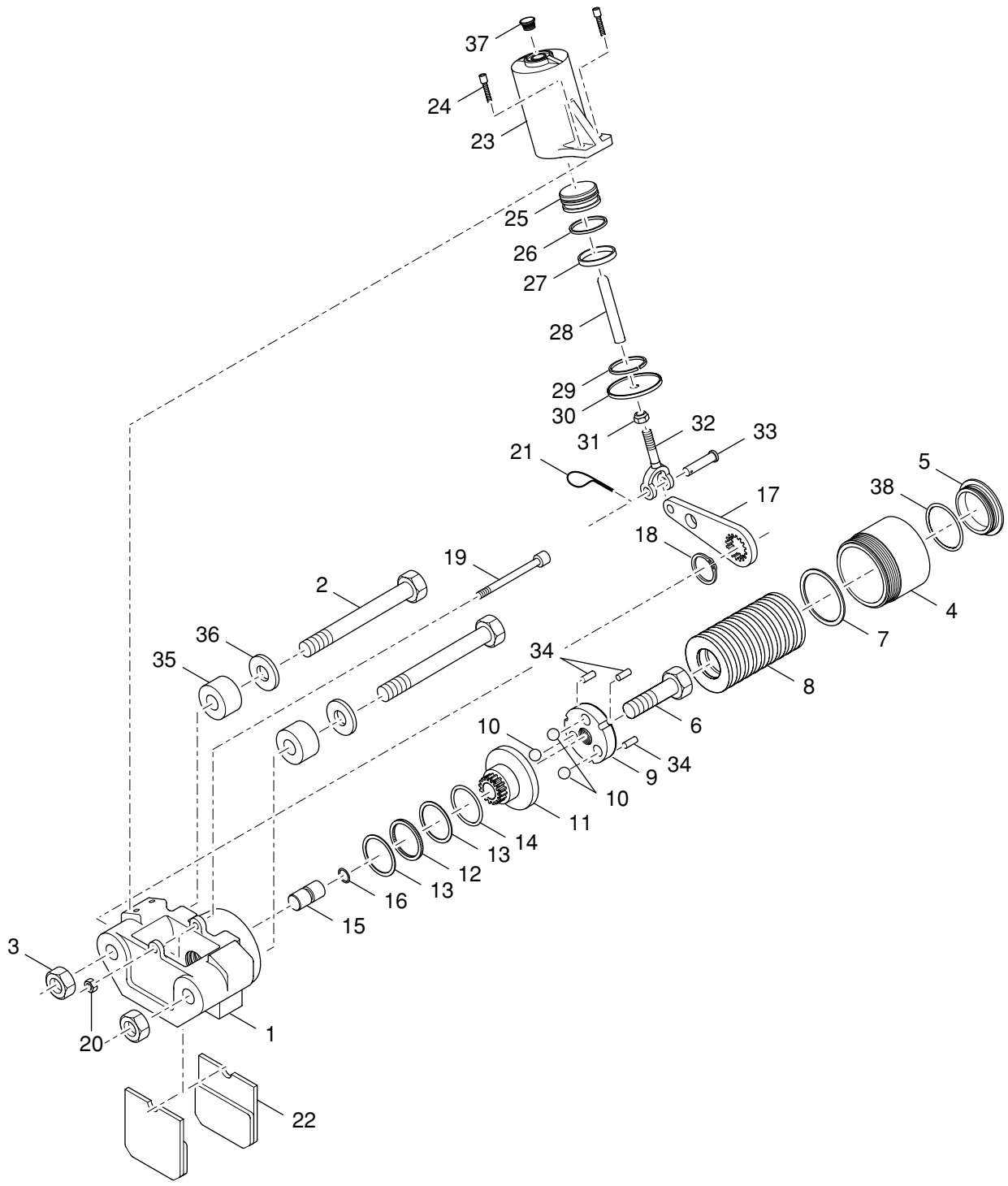
GROUP - DISC BRAKE (SPRING APPLIED HYDRAULIC RELEASED BRAKE (LOW PRESSURE))

Item	Description	Quantity
1	Caliper - Parking brake	1
2	Disc - Brake	1
3	Assembly - Mounting bracket	1
4	Screw - Bracket assembly to brg cap mtg	4
5	Washer - Bracket assembly to brg cap mtg flat screw	4
6	Screw - Flange	6
7	Spacer	4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SPRING APPLIED HYDRAULIC RELEASED BRAKE (LOW PRESSURE)

Item	Description	Quantity
1	Torque plate	1
2	Bolt - Hex	2
3	Jamnut	2
4	Housing - Spring	1
5	Plug	1
6	Bolt - Adjustment	1
7	Shim	AR*
8	Spring disc	10
9	Cam	1
10	Ball - Bearing	3
11	Cam	1
12	Bearing - Needle	1
13	Washer - Hardened	2
14	Seal - “O”-ring	1
15	Piston	1
16	Seal - “O”-ring	1
17	Lever	1
18	Ring - Retainer	1
19	Bolt	1
20	Nut	1
21	Pin - Cotters	1
22	Lining and carrier assembly	2
23	Cylinder - Hydraulic	1
24	Screw	2
25	Piston	1
26	Seal - STD poly pack	1
27	Sliding ring	1
28	Rod	1
29	Ring - Retaining	1
30	Rod excluder	1
31	Jamnut	1
32	Clevis	1
33	Clevis pin	1
34	Pin - Dowel	3
35	Spring - Urethane	2
36	Washer - Flat	2
37	Cap - Plug	1
38	Seal - “O”-ring	1

AR*: As Required

11.2.3.2 Operation

Ten disc springs (8) are used to hold the park brake in the actuated state.
The springs push the cams (9,11) and piston (15) into the lining and carrier assembly (22) which squeezes a driveline mounted disc.
The brake is released by fluid entering a SAE 7/16-20 threaded inlet in the top of the hydraulic cylinder (23) which pushes the piston (25) down, thereby rotating the lever (17) and cam (11), compressing the springs (8).

11.2.3.3 Adjustment and rebuild criteria

1. Apply hydraulic pressure to the brake.
2. Remove plug (5) and set running clearance (.020" - .030") using the adjustment bolt (6).
3. Replace plug (5).
4. Even up running clearance on each side of the disc by adjusting the carrier retaining bolt (19).

The brake should be rebuilt when one or more of the following criteria are met:

1. Any signs of fluid leakage.
2. Lining thickness less than .031".
3. Cracked or chipped linings.

11.2.3.4 Replacing friction pads

1. Apply hydraulic pressure to the brake and remove plug (5) and carrier retaining bolt (19).
2. With pressure applied remove adjustment bolt (6).
3. Release hydraulic pressure from the brake and remove lining and carrier assemblies (22).

11.2.3.5 Disassembly

Caution

IF THE PARK BRAKE IS BEING DISASSEMBLED WHILE ON THE VEHICLE, IT IS IMPORTANT TO FOLLOW THE FOLLOWING DIRECTIONS REGARDING THE REMOVAL OF THE SPRING HOUSING (4) AND THE LINING & CARRIERS (22) VERY CLOSELY.

1. Apply hydraulic pressure to the brake and remove plug (5) and carrier retaining bolt (19).
2. With pressure applied remove adjustment bolt (6).
3. Release hydraulic pressure from the brake and remove lining and carrier assemblies (22).
4. Use a spanner wrench to remove the spring housing (4) (counter-clockwise direction).
5. The springs (8) will be accessible when the spring housing is removed.
6. Remove hair pin (21) and pin (33) from the clevis (32).
7. Remove hydraulic cylinder (23) from torque plate (1) by removing cylinder mounting bolts (24).
8. Remove retaining ring (18) and lever (17) from the spline on the cam (11).
9. The opposing cams (9, 11), adjustment piston (15) and dowel pins (34) can be removed by pressing them out of the torque plate (1) from the lining and carrier (22) side.
10. Remove balls (10) and adjustment piston (15) from cams (9, 11).
11. The "O"-ring seal (16) can be removed from the adjustment piston (15) if necessary.
12. Remove needle bearing (12), hardened washers (13), and "O"-ring seal (14) from the torque plate (1) once the cams (9, 11) are removed.
13. Slide the rod (28) and clevis (32) out of the hydraulic cylinder (23).
14. Remove the rod excluder (30) from the hydraulic cylinder (23) by prying with a small screwdriver.
15. The retaining ring (29) may be removed once the rod excluder (30) has been removed.
16. Press piston (25) out of the hydraulic cylinder (23) by pushing on the top of the piston with a long slender rod.

Note

DO NOT SCAR CYLINDER WALLS OR NICK THE PISTON DURING REMOVAL.

11.2.3.6 Cleaning and inspection

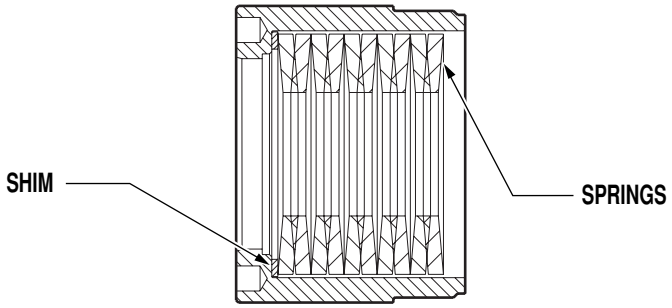
1. Clean all metal parts prior to assembly.
2. Blow excess cleaning solution off of all parts and out of all fluid passages.

11.2.3.7 Assembly

1. Apply a thin coat of fluid to seals (14,16).
2. Install seal (16) in seal groove on adjustment piston (15).
3. Slide the adjustment piston (12) into the bore located in the cam (11) until the seal (16) is inside the bore.
4. Install seal (14) in the grooves located in the small hole in the torque plate (1).
5. Install needle bearing (12) between the two hardened washers (13).
6. With bearing and washers (12,13) in place, install cam (11) and balls (10) into torque plate (1).
7. Install cam (9) and dowel pins (34) into torque plate (1).
8. Thread adjustment bolt (6) into the cam (9) until the bolt contacts the adjustment piston (15).
9. Place springs (8) in the torque plate (1).
   Springs should be placed in an alternating cupped face to cupped face orientation.
   The springs on the outside ends of the stack should be oriented cupped face out.
10. Replace the shim (7) in the bottom of the spring housing (4) before adding the springs if the brake contained a shim when it was disassembled. See illustration below for a graphical representation.

Note

SPRINGS ARE MATCHED AND PRETESTED.
IF NEW SPRINGS ARE BEING INSTALLED ADD A SHIM ONLY IF THE NEW SPRINGS ARE SHIPPED WITH ONE.



11. Apply a thin coat of Never-Seez to the spring housing (4) threads.
12. Screw spring housing (4) onto torque plate (1). Tighten with a spanner wrench until the spring housing face bottoms out on the counterbore face in the torque plate (1).
13. Assemble washer (36) and the urethane spring (35) on the mounting bolt (2) then slide mounting bolts through bolt holes in the torque plate (1).
14. Thread jam nut/sleeve (3) onto mounting bolt.
    The cylindrical part of the jam nut/sleeve should extend into the torque plate.
15. Apply a thin coat of fluid to seal (25) and sliding ring (27).
16. Install seal (25) and the sliding Ring (27) on the Piston (25).

17. Install piston (25) into the hydraulic cylinder (23) with the flat side facing the top of the cylinder.
18. Push the piston (25) to the top of the hydraulic cylinder (23) and install the retaining ring (29) in the groove at the bottom of the cylinder.

Note

MAKE SURE INLET PORT IS UNCAPPED WHEN INSTALLING PISTON (25).

19. Press rod excluder (30) with the rubber side facing out of the hydraulic cylinder (23).
20. Thread clevis (32) with the 3/8-16 jam nut installed into the rod (28).
21. Insert the rod (28) and clevis (32) through the rod excluder (30) into the hydraulic cylinder (23).
22. Position assembled hydraulic cylinder (23) onto torque plate (1) and install the cylinder mounting bolts (24) into their respective holes.
23. Pin clevis (32) to the lever (17) with clevis pin (33) and hair pin (21).
24. Adjust rod (28) until it contacts the rod retaining hole in piston (25) and tighten the jam nut.
25. Install lever (17) on the spline of cam (11).
    The centerline of the lever should be oriented parallel to the top of the torque plate (1).
26. Install retaining ring (18) in groove on the cam (11).
27. Install lining and carrier assemblies (22).
28. Thread carrier adjustment bolt (19) into hex nut (18) located in the slot in the back side of the torque plate (1).
29. After brake is mounted and adjusted, snap plug (5) onto spring housing (4).

11.2.3.8 Installation

1. Slide brake over disc and into the mounting position (per vehicle specification).
2. Start mounting bolts (2) into mounting surface far enough to just support the brake.
3. Remove plug (5) and tighten adjustment bolt (6) until linings (22) are clamped to the disc.
4. Tighten mounting bolts (2) until they make contact with the urethane springs (35), then tighten 1 to 2 flats more.
5. Tighten jam nut / sleeve (3) against mounting surface to torque shown in section 11.2.3.9.

Caution

BRAKE LININGS ARE SUSCEPTIBLE TO CONTAMINATION.
WHEN INSTALLING OR SERVICING BRAKES KEEP ALL OIL AND FLUIDS AWAY FROM THE LININGS.
POOR BRAKE PERFORMANCE MAY RESULT.

6. Attach brake line to inlet port located on the top of the hydraulic cylinder (23).

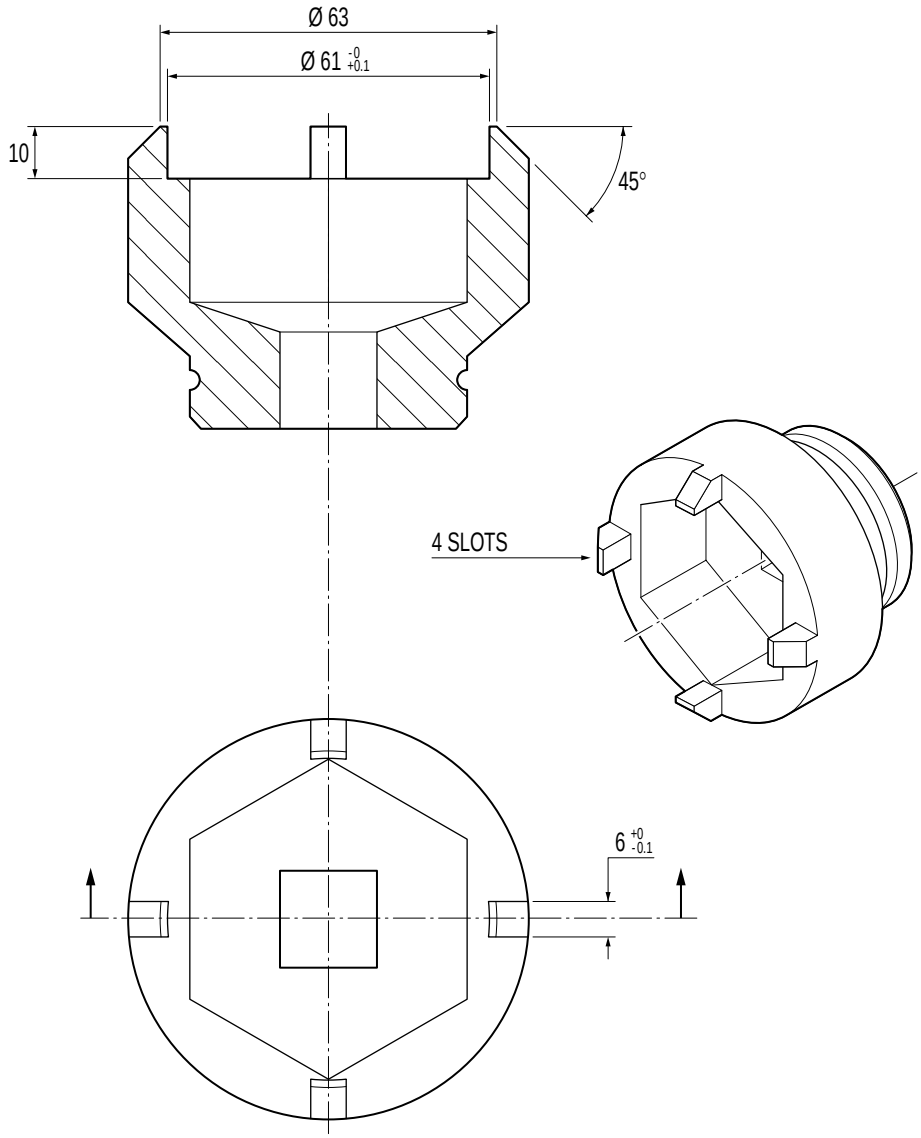
11.2.3.9 Torque specs

PART (ITEM NO.)	THREAD SIZE	DRY TORQUE
PLUG-INLET (37)	7/16 - 20	12/17 (LB-IN)
JAM NUT/SLEEVE (3)	3/4 - 10	200 (LB-IN)

12. SERVICE TOOLS

12.1 REVERSE IDLER SHAFT NUT SOCKET (TG 1304 - 54)

Made from Snap-on IM662A Socket 2 1/16” drive 3/4”.



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